

# **MCNEIL RIVER STATE GAME REFUGE AND STATE GAME SANCTUARY MANAGEMENT PLAN**

**JUNE 1996**

**Prepared by the Divisions of  
Habitat and Restoration  
and  
Wildlife Conservation**

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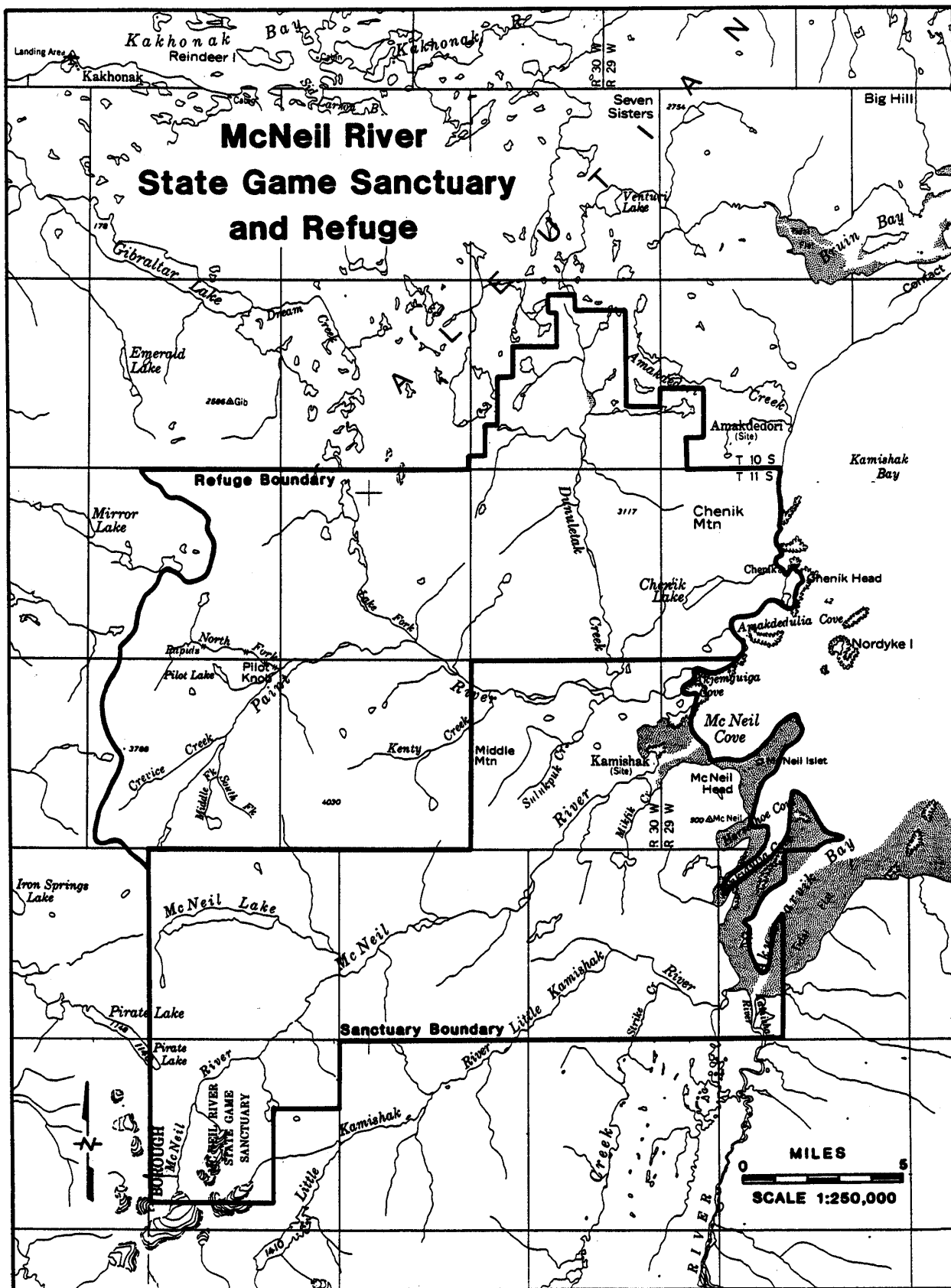
## **ACKNOWLEDGEMENTS**

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This plan has been developed with the aid of an interagency planning team composed of representatives from state, federal, and local agencies with jurisdiction over the refuge and sanctuary. Planning team members who participated in development of the plan are as follows: Yvonne Wu Goldsmith and Mary Walter, Department of Natural Resources; Deborah Gilcrest, Kenai Peninsula Borough; Gary Wheeler, U.S. Fish and Wildlife Service; John Westlund, Wildlife Conservation Division, ADF&G; James Brady, Commercial Fisheries Management and Development Division, ADF&G; Barry Stratton, Sport Fish Division, ADF&G; and C. Wayne Dolezal, Habitat and Restoration Division, ADF&G. James Fall, Subsistence Division, ADF&G; and Priscilla Wohl, Department of Environmental Conservation, were also named to the planning team.

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## INTRODUCTION

The McNeil River State Game Sanctuary was first established in 1967. In 1993, the sanctuary was expanded and the refuge was established. Both areas are established to provide permanent protection for brown bear and other fish and wildlife populations and their habitats, so that these resources may be preserved for scientific, aesthetic, and educational purposes; to manage human use and activities in a way that is compatible with this purpose and to maintain and enhance the unique bear viewing opportunities in the McNeil River State Game Sanctuary; to provide compatible opportunities for wildlife viewing, fisheries enhancement, fishing, temporary safe anchorage, other activities, and in McNeil River State Game Refuge, allow for hunting and trapping if compatible with sanctuary management objectives.

The purpose of the McNeil River State Game Refuge and Sanctuary Management Plan is to provide consistent, long-range guidance to the Alaska Department of Fish and Game (ADF&G) and other agencies involved in managing the refuge and sanctuary.

The plan presents management goals for the refuge and sanctuary and their resources, and identifies policies to be used in determining whether proposed activities within the refuge and sanctuary are compatible with the protection of fish and wildlife, their habitats, and public use of the refuge and sanctuary. The plan will be reviewed every five years and, if appropriate, updated as funding permits. Public participation will be solicited during the update process. The plan does not address hunting or fishing regulations which are the authority of the Boards of Fish and Game.

This plan is the result of a public planning process led by the ADF&G. The plan has been developed by the planning team representing state, federal, and municipal agencies including: the Alaska Departments of Fish and Game (ADF&G), Natural Resources (DNR), and Environmental Conservation (DEC); the U.S. Fish and Wildlife Service (USFWS); and the Kenai Peninsula Borough (KPB).

At the beginning of the public planning process, public meetings were held in Anchorage and Homer to explain the planning process and solicit citizens' opinions regarding the issues, interests, and concerns pertinent to refuge and sanctuary management. The meetings' results and written comments received were used by the planning team to identify a list of issues to be addressed in the plan. At the same time, resource information on fish and wildlife populations, other natural resources, existing land use, and land ownership was being collected and synthesized. This information, presented in both map and narrative form, comprises the plan's resource inventory presented in the Appendix. The planning team also made use of the September 1993 "McNeil River State Game Sanctuary and Refuge Draft

Operational Management Plan" prepared by the Division of Wildlife Conservation with the help of the McNeil River Advisory Group.

Management goals and policies for the refuge and sanctuary were developed by the planning team to address the identified issues. All policies were developed with consideration of their ability to meet the plan's management goals. In addition, other applicable laws and the Public Trust Doctrine were considered.

The draft plan was distributed for public review. Based on comments received during the review, appropriate changes were made and the Commissioner of Fish and Game adopted the plan for use by the department in managing the refuge and sanctuary.

Once adopted, the plan will be implemented by the ADF&G in several ways. A Special Area Permit is required for any habitat-altering activity, including any construction work, in a designated refuge or sanctuary (5 AAC 95). A Special Area Permit application form can be obtained from any ADF&G office and should be submitted to the Habitat and Restoration Division regional office in Anchorage. The Habitat and Restoration Division will review all proposed activities for consistency with the goals and policies outlined in the plan. Activities will be approved, conditioned, or denied based on the direction provided in the plan as well as other applicable state laws and regulations. Research programs, public use facilities, and other department projects will be consistent with the goals and policies presented in this plan.

Other state, federal, and local agencies have management responsibilities within the refuge and sanctuary as well. Any use, lease, or disposal of resources on state land in the refuge and sanctuary requires DNR authorization. Activities affecting air or water quality require authorization from DEC. The U.S. Army Corps of Engineers (COE) evaluates applications for discharging dredged and fill material in waters of the United States including wetlands. Federal and state agencies, including the USFWS, NMFS, and Environmental Protection Agency (EPA), along with local governments, review proposals for COE permits, pursuant to the Fish and Wildlife Coordination Act (16 USC 661-666 et. seq.). The Kenai Peninsula Borough reviews and comments on all permit proposals within the coastal zone, including the McNeil River State Game Refuge and Sanctuary. Review of activities requiring more than one type of authorization will be coordinated through the Division of Governmental Coordination (Office of the Governor) for a finding of consistency with the Alaska Coastal Management Program.

## STATUTES

Alaska statutes which pertain specifically to the establishment and management of the McNeil River State Game Refuge and Sanctuary are as follows:

AS 16.20.041. McNeil River State Game Refuge. (a) The following state-owned land and water, including the tideland but exclusive of marine water and submerged land, lying within the parcels described in this subsection is established as the McNeil River State Game Refuge:

Township 10 South, Range 29 West, Seward Meridian

Section 19: S  $\frac{1}{2}$

Section 20: SW  $\frac{1}{4}$

Section 29: W  $\frac{1}{2}$

Sections 30 - 31

Township 10 South, Range 30 West, Seward Meridian

Section 3: SW  $\frac{1}{4}$

Section 4: SE  $\frac{1}{4}$

Sections 10 - 11

Sections 14 - 16

Section 17: E  $\frac{1}{2}$

Sections 20 - 23

Sections 25 - 29

Section 30: SE  $\frac{1}{4}$

Section 31: NE  $\frac{1}{4}$ , S  $\frac{1}{2}$

Sections 32 - 36

Township 11 South, Range 29 West, Seward Meridian

Sections 1 - 35

Section 36, except Nordyke Island and its tideland

Township 11 South, Range 30 West, Seward Meridian

Sections 1 - 36

Township 11 South, Range 31 West, Seward Meridian

Sections 1 - 36

Township 11 South, Range 32 West, Seward Meridian

Sections 1 - 36, except land within Katmai National Park and Preserve

Township 12 South, Range 31 West, Seward Meridian

Sections 1 - 36

Township 12 South, Range 32 West, Seward Meridian  
Sections 1 - 36, except land within Katmai National Park and Preserve

Township 13 South, Range 33 West, Seward Meridian  
Section 1, except land within Katmai National Park and Preserve.

- (b) The McNeil River State Game Refuge is established to
  - (1) provide permanent protection for brown bear and other fish and wildlife populations and their habitats, so that these resources may be preserved for scientific, aesthetic, and educational purposes;
  - (2) manage human use and activities in a way that is compatible with (1) of this subsection and to maintain and enhance the unique bear viewing opportunities in the McNeil River State Game Sanctuary established under AS 16.20.160;
  - (3) provide opportunities that are compatible with (1) of this subsection for wildlife viewing, fisheries enhancement, fishing, hunting, and trapping, for temporary safe anchorage, and for other activities.
- (c) The Board of Game shall determine whether hunting of brown bears within the McNeil State Game Refuge should be prohibited.
- (d) The use and enjoyment of valid rights and interests in mineral claims, including the right of access, within the McNeil River State Game Refuge is protected. This subsection does not affect the power of the commissioner of natural resources to open or close land within the McNeil River State Game Refuge to new mineral entry under AS 38.05.185 - 38.05.275.
- (e) The department and the Department of Natural Resources
  - (1) may not enter into sales of land within the McNeil River State Game Refuge;
  - (2) may enter into leases within the McNeil River State Game Refuge if the commissioner finds that activity conducted under the lease is compatible with the purposes for which the refuge is established.
- (f) The commissioner shall prepare a report and notify the legislature of its availability by January 30 of each year on
  - (1) the status of the brown bears and other fish and wildlife resources within the McNeil River State Game Refuge; and

- (2) the effect of hunting, fishing, and trapping, fishery enhancement activity, and mineral resource development on these resources.

AS 16.20.160. McNeil River State Game Sanctuary. The following state-owned land and water, including the tidelands but exclusive of marine water and submerged land, lying within the parcels described in this subsection is established as the McNeil River State Game Sanctuary:

Township 12 South, Range 29 West, Seward Meridian  
Sections 1 - 36

Township 12 South, Range 30 West, Seward Meridian  
Sections 1 - 36

Township 13 South, Range 29 West, Seward Meridian  
Sections 5 - 8  
Sections 17 - 20  
Sections 29 - 32

Township 13 South, Range 30 West, Seward Meridian  
Sections 1 - 36

Township 13 South, Range 31 West, Seward Meridian  
Sections 1 - 36

Township 13 South, Range 32 West, Seward Meridian  
Sections 1 - 36

Township 14 South, Range 32 West, Seward Meridian  
Sections 1 - 12  
Sections 15 - 22  
Sections 27 - 30

AS 16.20.162. Purpose; regulations. (a) The McNeil River State Game Sanctuary is established to

- (1) provide permanent protection for brown bear and other fish and wildlife populations and their habitats, so that these resources may be preserved for scientific, aesthetic, and educational purposes.
- (2) manage human use and activities in a way that is compatible with (1) of this subsection and to maintain and enhance the unique bear viewing opportunities within the sanctuary; and

- (3) provide opportunities that are compatible with (1) of this subsection for wildlife viewing, fisheries enhancement, and fishing, for temporary safe anchorage, and for other activities.
- (b) Hunting and trapping within the McNeil River State Game Sanctuary are prohibited.
- (c) The department and the Department of Natural Resources
  - (1) may not enter into sales of land within the McNeil River State Game Sanctuary;
  - (2) may enter into leases within the McNeil River State Game Sanctuary if the commissioner finds that activity conducted under the lease is compatible with the purposes for which the sanctuary is established.
- (d) The McNeil River State Game Sanctuary is closed to mineral entry under AS 38.05.185 - 38.05.275.
- (e) The boards may adopt regulations governing access, entry, development, construction, fishing, and other uses and activities affecting the natural habitat, fish and wildlife, and public use of the McNeil River State Game Sanctuary.
- (f) The commissioner shall prepare a report and notify the legislature of its availability by January 30 of each year on
  - (1) the status of the brown bears and other fish and wildlife resources within the McNeil River State Game Sanctuary; and
  - (2) the effects of fishing and fishery enhancement activity on these resources.

## STATUTORY GOALS

Activities within the **McNeil River State Game Sanctuary** will reflect the following goals in accordance with the purpose for which the area was established. All department management decisions in the McNeil River State Game Sanctuary, whether affecting activities undertaken by the department, other agencies, or the public will be in accordance with these goals.

- I. **Fish and Wildlife Populations and Their Habitat** - Manage the sanctuary to provide permanent protection for brown bear and other fish and wildlife populations and their habitats for the following purposes:
  - A. Scientific.
  - B. Aesthetic.
  - C. Educational.
- II. **Public Use** - Manage human activities in the sanctuary compatible with Goal I and with maintaining and enhancing the unique bear viewing opportunities in the sanctuary including:
  - A. Provide opportunities for wildlife viewing.
  - B. Provide opportunities for fisheries enhancement.
  - C. Provide opportunities for fishing as allowed by the Board of Fisheries.
  - D. Provide opportunities for temporary safe anchorage.

Activities within the **McNeil River State Game Refuge** will reflect the following goals in accordance with the purpose for which the area was established. All department management decisions in the McNeil River State Game Refuge, whether affecting activities undertaken by the department, other agencies, or the public will be in accordance with these goals.

- I. **Fish and Wildlife Populations and Their Habitat** - Manage the refuge to provide permanent protection for brown bear and other fish and wildlife populations and their habitats for the following purposes:
  - A. Scientific.

- B. Aesthetic.
  - C. Educational.
- II. **Public Use** - Manage human activities in the refuge compatible with Goal I and with maintaining and enhancing the unique bear viewing opportunities in the McNeil River State Game Sanctuary including:
- A. Provide opportunities for wildlife viewing.
  - B. Provide opportunities for fisheries enhancement.
  - C. Provide opportunities for fishing, hunting, and trapping where allowed by the Boards of Fisheries and Game.
  - D. Provide opportunities for temporary safe anchorage.

## **POLICIES**

### **ACCESS**

**Refuge Policy:** Maintain existing public access for continued public use and research compatible with the goals of the management plan. Do not allow the development of airstrips on the refuge.

**Sanctuary Policy:** Authorize public access to the sanctuary through the wildlife conservation access permit process (5 AAC 92.065). Do not allow the development of airstrips in the sanctuary. Where appropriate, issue a general permit for pedestrian access to beaches consistent with management goals and policies of this management plan.

### **OFF-ROAD USE OF MOTORIZED VEHICLES**

**Refuge Policy:** To ensure the protection of sensitive habitats and avoid harmful disturbance to fish and wildlife, the department will not allow the off-road use of wheeled or tracked motorized vehicles in the refuge for recreational use, whether private or commercial. Landing aircraft in the vicinity of Chenik in the spring and snowmachine access to the refuge in the winter for the purpose of trapping may be authorized by general special area permit. Except as noted above, the department will, in its discretion, issue an individual special area permit under 5 AAC 95 for the off-road use of a wheeled, tracked or other ground-effect motorized vehicle if the use is consistent with the goals and policies of this management plan and fulfills a demonstrable need for which there is no feasible alternative.

**Sanctuary Policy:** To ensure the protection of sensitive habitats and avoid harmful disturbance to fish and wildlife do not allow the off-road use of wheeled or tracked motorized vehicles in the sanctuary. Access by helicopter, floatplane, or boat may be allowed through the wildlife conservation access permit process (5 AAC 92.065) consistent with the goals of the management plan.

### **INFORMATION/EDUCATION**

**Refuge/Sanctuary Policy:** Provide information to refuge and sanctuary users regarding resource values and rules, especially information about avoiding impacts to natural brown bear behavior, and uses and activities occurring in the refuge and sanctuary. Where appropriate, provide information at points of departure to the refuge and sanctuary or place information signs at access points including Paint River Lakes.

## **SCIENTIFIC RESEARCH**

**Refuge/Sanctuary Policy:** Encourage compatible scientific research of fish, wildlife, and habitat resources and their use.

## **RECREATIONAL ACTIVITIES MENTIONED IN STATUTE**

**Refuge Policy:** Low intensity recreational activities including wildlife viewing, hunting, trapping, and fishing, may be allowed in the refuge under terms and conditions compatible with the goals and policies of this management plan and the purposes for which the refuge was established.

**Sanctuary Policy:** Low intensity recreational activities, including the bear viewing program, and fishing may be allowed in the sanctuary through access permits, under terms and conditions compatible with the goals and policies of this management plan and the purposes for which the sanctuary was established.

## **ARCHÆOLOGICAL AND HISTORICAL RESOURCES**

**Refuge/Sanctuary Policy:** Protect archæological and historical resources located within the refuge and sanctuary. Where appropriate, allow legal investigation of archæological and historical resources through a special area permit under terms and conditions consistent with the goals and policies of this plan and the purpose for which the refuge and sanctuary were established.

## **HABITAT AND POPULATION ENHANCEMENT**

**Refuge/Sanctuary Policy:** As appropriate, allow enhancement of fish and wildlife populations and their habitats if it is compatible with statutory goals of the area, especially the permanent protection of brown bears and the unique brown bear viewing opportunities of the sanctuary, is not at the expense of refuge and sanctuary resource values (including diversity and abundance), and does not interfere with public use and enjoyment.

## **NON-COMMERCIAL CAMPING**

**Refuge Policy:** To protect fish and wildlife habitat, conserve fish and wildlife populations, and maintain public use opportunities in a high quality environment, dispersed seasonal camping is allowed in the refuge, however establishment of a camp in excess of 14 consecutive days or relocating a camp within a 14-day period within a two-mile radius of the previous 14-day camp requires authorization through a special area permit. Solid waste disposal is not allowed within the refuge. Food and garbage must be kept in bear-proof containers. Unburned garbage must be removed from the refuge. If measurable impacts to

brown bear viewing in the sanctuary is attributed to camping activities in the refuge, specific campsites should be established and camping activity limited.

**Sanctuary Policy:** To protect fish and wildlife habitat, conserve fish and wildlife populations, and maintain unique brown bear viewing opportunities in the sanctuary, camping in the sanctuary may be allowed through the wildlife conservation access permit process (5 AAC 92.065), in designated locations. In addition, establishment of a camp in excess of 14 consecutive days or relocating a camp within a 14-day period within a 2-mile radius of a previous camp requires authorization through a special area permit.

## **COMMERCIAL FACILITIES/STRUCTURES**

**Refuge/Sanctuary Policy:** To protect fish and wildlife habitat, conserve fish and wildlife populations, and maintain public use opportunities in a high quality environment, permanent commercial facilities will not be allowed in either the refuge or the sanctuary except that the commissioner will, in the commissioner's discretion, allow a permanent commercial facility in the refuge specifically for the purpose of facilitating the brown bear viewing program under appropriate terms and conditions and in a manner compatible with the purpose for which the area is established, only after a finding of fact indicates that refuge and sanctuary management goals are better served with a commercial facility than without. Temporary structures (not exceeding one season's use) including tent platforms may be allowed by individual special area permit only if they meet a public need for which there is no feasible alternative and are compatible with maintaining the brown bear viewing opportunities in the sanctuary. Use of temporary structures does not convey any future or exclusive rights. To allow for monitoring of levels and periods of use, permits for commercial operations will include a requirement to report frequency, location, and timing of aircraft landings in the refuge and sanctuary and numbers of visitors transported.

## **OIL AND GAS**

**Refuge/Sanctuary Policy:** To avoid damage to fish and wildlife habitats, disturbance to fish and wildlife populations (especially impacts to brown bears), and displacement of public use in a high quality environment, surface entry for oil and gas development and transportation, including supplies and equipment storage for off shore exploration or development, will not be allowed in the refuge or sanctuary. Exploration may be allowed under terms and conditions compatible with statutory goals, including appropriate restrictions.

## **MINING**

**Refuge Policy:** Recommend that the legislature close the refuge to new locatable mineral entry and mineral leasing and close tidelands in the refuge to the issuance of offshore prospecting permits under AS 38.05.185-38.05.275. Mining of valid existing leases may occur under special area permit in a manner compatible with the goals and policies of this management plan and the terms and standards of 5 AAC 95.

**Sanctuary Policy:** The sanctuary is closed to mineral entry under AS 38.05.185 - 38.05.275 in accordance with AS 16.20.162(d).

## **MATERIAL EXTRACTION**

**Refuge/Sanctuary Policy:** All material extraction activities within the refuge or sanctuary must be consistent with the goals and policies of this management plan. Impacts will be fully mitigated including, if appropriate, rehabilitation and restoration. Avoid material extraction within the refuge or sanctuary unless for purposes of maintenance, enhancement, restoration, or management of the refuge or sanctuary. Material extraction may be allowed for other authorized activities where there is a demonstrable need and no feasible alternatives.

## **HAZARDOUS SUBSTANCES AND PETROLEUM-BASED FUEL**

**Refuge/Sanctuary Policy:** Hazardous substances may not be stored or deposited in the refuge or sanctuary. Temporary personal fuel supplies of 20 gallons or less are allowed in the refuge or sanctuary without a special area permit and greater amounts may be allowed by special area permit. This policy does not apply to fuel on board vessels or aircraft.

## **ROADS/DOCKS/PIPELINES/UTILITY LINES**

**Refuge/Sanctuary Policy:** To prevent damage to fish and wildlife habitats and disturbance to fish and wildlife populations, especially brown bears that seasonally use the refuge or sanctuary, do not allow construction of new permanent roads, pipelines, utility lines, or docks in the refuge or sanctuary. A temporary (life of the project) road may be allowed in the refuge consistent with the management goals where it fulfills a demonstrable need for which there is no feasible alternative. Impacts will be fully mitigated including, if appropriate, rehabilitation and restoration.

## **SANCTUARY AND REFUGE MANAGEMENT FACILITIES**

**Refuge/Sanctuary Policy:** To facilitate management of the refuge and sanctuary and administration of the brown McNeil River brown bear viewing program, construction, maintenance, and upgrade of cabins, campgrounds, associated facilities, and the brown bear

viewing area may be permitted. Facilities should be sited and constructed consistent with the primitive character of the area and compatible with the goals of this management plan.

## **GRAZING**

**Refuge/Sanctuary Policy:** With the exception of incidental grazing of pack animals, the grazing of domestic or feral animals within the refuge or sanctuary is prohibited.

## **TIMBER HARVEST**

**Refuge/Sanctuary Policy:** Timber harvest is prohibited in the refuge or sanctuary. Dead and down wood may be used for personal use within the refuge or sanctuary.

## **ECOSYSTEM INTEGRITY**

**Refuge/Sanctuary Policy:** Allow only those uses and activities that will not compromise the integrity of the refuge and sanctuary ecosystem. Do not allow the introduction of exotic plant or animal species, whether wild or feral, unless for purposes described in the Habitat and Population Enhancement Policy.

## **OTHER USES**

**Refuge/Sanctuary Policy:** To protect fish and wildlife populations and their habitats in the refuge and sanctuary, the department may allow by permit only those activities compatible with the purposes for which the refuge or sanctuary was established, terms and standards of 5 AAC 95, and the goals and policies of the plan. Any activity that is not compatible with the purposes for which the refuge and sanctuary were established, terms and standards of 5 AAC 95, and the goals and policies of this plan will not be allowed.

## IMPLEMENTATION

The McNeil River State Game Refuge and Sanctuary Management Plan will be implemented by the ADF&G through its day-to-day, on-the-ground management activities, through its annual budgetary process, and through Special Area Permits issued for land use activities.

Special Area Permits - A Special Area Permit is required for any habitat-altering activity, including construction work, in the McNeil River State Game Refuge and Sanctuary. A Special Area Permit application form can be obtained from any ADF&G office and should be submitted to the Habitat and Restoration Division office in Anchorage (5 AAC 95).

Information/Education - Work with government agencies and private groups to develop an information/education program for the refuge and sanctuary which will inform the public about resource values, rules, and recreational opportunities. Work with air charter operators and the Federal Aviation Administration to explain aircraft access limitations.

Mining Claims and Leasehold Locations - Work with the Department of Natural Resources to review the status of mining claims, close out all lapsed claims, and prepare mineral closing orders for the refuge.

Bureau of Land Management - Work with the Bureau of Land Management to resolve the status of state selected lands in the McNeil River State Game Refuge.

Paint River Fish Ladder - For the purposes of implementing this plan, the Paint River Fish Ladder is not considered a commercial facility/structure.

Developed Access - Where feasible the department should ensure that developed public access can accommodate disabled visitors, consistent with safety and the wilderness character of the area.

Other Agencies' Activities - This plan will also be used by other state, federal, and local decision makers in making management decisions for the refuge and sanctuary under their respective statutory authorities.

# APPENDIX

**MCNEIL RIVER  
STATE GAME REFUGE AND STATE GAME SANCTUARY  
RESOURCE INVENTORY**

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## AREA DESCRIPTION

McNeil River State Game Sanctuary (MRS GS) encompasses all of the area draining into McNeil Cove including Mikfik Creek and McNeil River, the lower six miles of the Paint River, and the lower one mile of the Kamishak River. Immediately to the north of the sanctuary is the McNeil River State Game Refuge (MRS GR). The primary drainages in the refuge are the Chenik Creek system and Paint River including the northern tributary known as Dunuletak Creek and minor tributaries Sulukpuk, Kenty, and Crevice creeks.

The sanctuary and refuge are located on the west side of lower Cook Inlet on the shores of Kamishak Bay. The sanctuary and refuge are approximately 100 miles directly west of Homer across Cook Inlet and 210 miles southwest of Anchorage. The sanctuary is about 200 square miles (128,000 acres) and the refuge is about 188 square miles (120,120 acres) combining to protect approximately 388 square miles (248,120 acres) of bear habitat. The sanctuary and refuge are immediately north and east of the Katmai National Park and Preserve (KNPP).

Kamishak Bay is characterized by extreme tidal fluctuations. In a typical year the highest tides are over 23 feet and the lowest are -5 feet. Kamishak Bay has numerous reefs and shoals rising to within a few feet of the surface scattered throughout the area, with many exposed at low tide. The south shore of Kamishak Bay is foul with extensive reefs and ledges and adjoining mudflats (United States Coast Pilot No.9, 1989). Sea currents generally run counterclockwise in Cook Inlet. Thus sea currents into Kamishak Bay are primarily from the north (Burbank 1977).

The land is characterized by rolling foothills of the Aleutian Range. Mountains in the sanctuary and refuge are under 4,700 feet elevation. Vegetation is predominantly dense thickets of willow (*Salix spp.*) and alder (*Alnus spp.*) interspersed by patches of grasses. Woody vegetation ends at about the 1,000 foot level. There are a few balsam poplars (*Populus balsamifera*) spread throughout the lower riparian areas. There are also extensive tidal flats with large areas of sedge (*Carex spp.*) in McNeil Cove and the mouth of Kamishak River. The area has been well described elsewhere (Bledsoe 1987, Walker & Aumiller 1993).

## ARCHAEOLOGY AND HISTORY

Kamishak Bay has a number of historical variations of its name, including Bourdiens Bay, Bourdieus Bay, Kamieshatskia Bay, Kamiischatskaja Bay, Kamiskuk Bay, Kamychatskoi Bay, Kamyshak Bay, and Kamyshatskaya Bay (Orth 1967:491).

The earliest and only reference to Russian entry into Kamishak Bay was a reference to a damaged Russian ship making an unplanned landing at an unspecified location in 1796 (Thornfelt and Burwell 1992). The ship *Tri Sviatitelia*, ("three sisters") commanded by Medvednikov was caught in a storm and blown ashore in Kamishak Bay. Four crew members were lost. Alexander Bandnov sent a crew of carpenters to the site in the spring of 1797 to repair the ship. But the ship was beyond repair and was abandoned (Thornfelt and Burwell 1992).

Captain George Vancouver's map drawn from explorations in Cook Inlet in 1794 recorded the area now known as Kamishak Bay as "Bourdieu Bay" (Vancouver 1798). However, since Vancouver does not mention giving the name Bourdieu Bay in his journals, Wagner speculates that Captain George Dixon actually bestowed the name during his visit to Cook Inlet in 1787 (Wagner 1937:434).

The native name published by the early Russians was "Guba Kamyshatskaya" meaning "Kamyshatskaya Bay" (Sarychev 1969). Boraas and Petersen speculate that the name is probably a Russianized version of an Aleutiq Eskimo name for the bay, though there was not a recorded translation. They felt the Russian name was then Anglicized to Kamishak (Boraas and Peterson 1988).

No permanent settlements are noted as existing in Kamishak Bay in the Department of Interior census report of 1890. Some seasonal use, however, was noted:

"Along the shores of Kamishak Bay, between St. Augustine Island on the north and Cape Douglas on the south, numerous camps of sea otter hunters can be found every season from early spring until late in autumn. These camps are occupied by Kiatagmiut, Aglemiut, and Togiagmiut Eskimo, who, under instigation of traders, undertake long, tedious journeys, transporting their household goods and skin canoes on sledges over tundra, rivers, lakes, and mountain ranges, before the snow melts in the spring, to return only when the first storms of autumn make sleighing possible again. The Togiagmiut, whose villages are located far to the westward of Bristol Bay, must cover between 200 and 300 miles in their journeys to this hunting ground. All through the winter the shores of the Kamishak are deserted and desolate, a wilderness of barren rock and drifting snow, the battlefield of furious gales, and trembling before the unceasing onslaught of a raging sea, kept in a state of turmoil by the joint action of wind and tide" (Porter 1893).

No prehistoric and only two historic sites are listed as having existed in either the sanctuary or refuge. Listed on the Alaska Heritage Resource Survey the historic sites are:

Site ILI-007: The Eskimo village of Chenik located about 8 miles north of Paint River. The site was reported as the location of an Eskimo village by A.H. Brooks in 1925 but has since been abandoned.

Site ILI-045: Kamishak, or McNeil Ranch, the site consists of a log cabin occupied by Charlie McNeil in 1923 and located on the north bank at the mouth of McNeil River.

An archaeological survey was conducted at the mouth of Paint River in 1988 as a permit requirement for the construction of the salmon ladder. No prehistoric or historic sites were identified in an on-site inspection of the approximately one-quarter by one-quarter mile project area (Boraas, Petersen 1988).

McNeil River was named for (or by) Charles McNeil, a miner, who frequented the area between approximately 1911 to 1923. (Walker & Aumiller 1993, Mather 1923). There is no record of what McNeil River was called prior to this. Mikfik Creek is apparently a local Eskimo name as is Chenik Creek (Brooks and others 1925). The origins of the name for Paint River is less clear. It is also first reported in Brooks and others 1925. Paint River was also called Ach-check River by Charles McNeil in his certification of location for his mining claims on Paint River.

The sanctuary was created in 1967. Legislation to expand it was passed in 1991 and went into effect in 1993. Legislation establishing the refuge was passed in 1991 and went into effect in 1993 when the Paint River Fish Ladder was declared operational by the Commissioner of Fish and Game. The expanded sanctuary and refuge encompass state owned lands and waters, including tide lands. Marine waters and submerged lands are not included.

## **PHYSICAL ENVIRONMENT**

### **CLIMATE AND WEATHER**

Climate and weather has never been systematically recorded or described in Kamishak Bay except for summer weather anecdotally recorded in McNeil River Cove (Aumiller, pers. commun.). Aumiller reports that in the summers of 1975 and 1976, 56% of the days at McNeil Cove were at least partly cloud-free, had winds less than 15 mph, and had no rain. Twenty-five percent of the days had at least some rain or winds in excess of 15 mph and total cloud cover, and 14% of the days had total cloud cover, at least some rain, and winds in excess of 15 mph. The highest recorded summertime wind velocity was 80 mph in August of 1985 (Aumiller, pers. commun.).

Other visitors have recorded their observations in a variety of publications:

- "All next day the wind blew unabated, driving white spray 60 feet or more into the air off the cliffs." Cecil Rhode, National Geographic Magazine, August 1954 pp 195-205.
- "Since the Alaska Peninsula is exposed to storms blowing across the Gulf of Alaska, driving rain, gale force winds and low clouds are common." John Ibbotson, Adventure Travel Magazine, August 1980 pp 28-33.
- "The weather out there on the Alaska Peninsula is thick enough to swim in." Jose deCreeft reported in "Wild Alaska", a book by Erwin Bauer.

Kamishak Bay is reported as having an average of 40 inches of annual snowfall. Summer temperatures of between 45 and 60°F and typical winter temperatures of 10 to 25°F are also reported. There is no permafrost in the area (Selkregg 1974).

The sanctuary and refuge both stretch inland approximately 25 miles going from sea level to about 4,000 feet. Although the primary influence is a moderate maritime climate, the area is large enough that other factors, including altitude, are important. The summers are generally cool and wet and the winters have moderate temperatures, wind, and 40-60 inches of snow (Selkregg 1974).

## **GEOLOGY**

The sanctuary and refuge consist of two primary geological formations separated by the Bruin Bay Fault (Detterman and Reed 1980). The Bruin Bay Fault bisects the sanctuary and refuge running generally northeast to southwest. This fault has its origins at Mt. Susitna on the west side of Cook Inlet across from Anchorage and runs about 300 miles southwest to Lake Becharof on the Alaska Peninsula. The fault emerges from under the sea at about the northern border of the refuge, near the southern end of Amakdedori Beach. It generally runs southwest splitting the distance between McNeil River and Little Kamishak River. The Bruin Bay Fault and other minor faults are closely associated with waterfalls on Kirschner Creek, Chenik Creek, Paint River, McNeil River, Mikfik Creek and Strike Creek (Detterman and Reed 1980).

On the eastern side of the fault exists the Naknek Formation consisting mainly of sedimentary arkosic arenite; arkosic and lithic wacke; conglomerate; and sandy siltstone (Detterman and Reed 1980). The base of the formation is a massive cobble boulder

conglomerate (Chisik conglomerate) that was formed under pressure and high temperature. The western shore of Kamishak Bay from a point two miles north of Chenik southward to the mouth of the Kamishak River is formed of comparatively flat-lying beds of Chisik conglomerate. This formation extends up the Little Kamishak River and then reappears along upper Strike Creek (Mather 1923). McNeil Head, which rises from the sea several hundred feet, is an excellent example of the Chisik conglomerate. Also, spread throughout the area east of the fault are boulders of various types of granite and metamorphic rocks which form the mountains west of Kamishak Bay. These are called glacial erratics and were deposited by glaciers during the last ice age, the Cretaceous, about 10,000 years ago (Richter and Herreid 1965).

Other geologic features in the sanctuary and refuge east of the Bruin Bay Fault are floodplain deposits, beach sand and gravel, and glacial outwash of the coastal and riparian areas (Mather 1923).

West of the Bruin Bay fault exist igneous quartz diorite formations which include biotite and hornblende, and locally small areas of diorite and granodiorite (Detterman and Reed 1980). In descending size of area, there are also examples of surficial deposits (weathered by alluvial, colluvial, glaciofluvial, lacustrine, marine, and eolian actions), the Talkeetna formation (andesite flows, agglomerate, tuff, and volcanic breccia), and lastly the Kamishak formation (gray and black limestone, gray and black chert, and gray ruff). Very small areas of intrusive rock (granodiorite, quartz monzonite, and quartz diorite) exist in the headwaters of the Paint River.

## **BIOLOGICAL RESOURCES**

### **MARINE VEGETATION**

No formal surveys of marine vegetation, phytoplankton or macrophytes (seaweeds) have been conducted in either the sanctuary or refuge. Nearshore marine vegetation is presumed to be dominated by various species of marine algae, including species of *Fucus*, *Laminaria*, *Porphyra*, *Alaria*, and *Ulva* (The Alaskan vegetation classification, Viereck et. al. 1992).

### **TERRESTRIAL VEGETATION**

In elevations below approximately 1,000 feet, the sanctuary and refuge are predominantly covered by open tall alder-willow vegetation communities (Viereck et al. 1992). Open alder-willow communities consists of 25 - 75% alder and willows less than 5 feet tall. Grasses (*Calamagrostis* spp.) are abundant. The notable exception is an area near the mouth of the Kamishak River which is classified as closed broadleaf forest canopy which consists of over 60% balsam poplars. There are also small stands or single examples of balsam

poplar spread throughout the area. There also exists in both the sanctuary and refuge very rare single examples of spruce trees, thought to be *Picea sitchensis* (Aumiller, pers. commun). ADF&G sanctuary staff have catalogued over 100 flowering plants in the sanctuary and refuge (Table 1). Above 1,000 feet the plant community changes to alpine tundra which continues generally upland to about the 1,500 foot level at which most vegetation gives way to lichens or rocks.

## MARINE INVERTEBRATES

The southern shore of Kamishak Bay does not support a large number or much diversity of marine invertebrates. Amakdedulia Cove, Akjemguiga Cove, McNeil Lagoon, Horseshoe Cove, Pinkidulia Cove, and Akumwarvik Bay all have extensive areas of mudflats (with a few boulders and rock reefs) (N.O.A.A. 1989; Aumiller, pers. commun). This type of substrate provides limited habitat for marine invertebrates, primarily because of exposure, freezing, and seasonal ice scour. The ADF&G staff in McNeil Lagoon have, however, identified the following marine invertebrates:

Jellyfish:	<i>Staurophora</i> spp.
Limpets:	<i>Notoacmea</i> spp.
Mussels:	<i>Mytilus edulis</i>
Cockles:	<i>Clinocardium</i> spp.
Clams:	<i>Siliqua patula</i> , <i>Mya</i> spp.
Barnacles:	<i>Balanus glandula</i> <i>Lepas pacifica</i>
Amphipods:	<i>Anonyx</i> spp.
Hermit crabs:	Species unknown

After severe storms, other marine invertebrates are washed to the beaches, suggesting that suitable habitat for other species exist seaward of the mud flats. On Amakdedori beach which is immediately north of Chenik Lagoon, over 60 species of marine life have washed ashore and been identified (Cunning 1977, Table 2). The majority of these organisms were sea squirts, (*Halosynthia aurantium*), Goose barnacles, (*Lepas* spp.) or mussels, (*Mytilus edulis*).

## TERRESTRIAL INVERTEBRATES

Insects and other invertebrates have not been scientifically surveyed in either the sanctuary or refuge but the following orders of invertebrates have been noted: Odonata (dragonflies), Lepidoptera (butterflies), Coleoptera (beetles), Lepidoptera (moths), Diptera (flies), Hymenoptera (wasps and bees), Trichoptera (caddisflies), Mallophaga (chewing lice [bird lice]), Hemiptera (water bugs), and Siphonaptera (fleas [parasites on bears]). The following orders have not been noted in either the sanctuary or refuge: Orthoptera (grasshoppers,

crickets or cockroaches), Dermaptera (earwigs), Mecoptera (scorpion flies), and Isoptera (termites) (Aumiller, pers. commun.).

## **FRESHWATER AND ANADROMOUS FISH**

Anadromous fish for all of the major freshwater rivers and creeks in the sanctuary and refuge have been catalogued by the ADF&G (ADF&G 1993). Chenik Creek contains sockeye salmon (*Oncorhynchus nerka*) and Arctic char (*Salvelinus alpinus*) and, prior to the 1940s, was historically an excellent sockeye salmon producer. However, by the mid-70s the annual return to this system was less than 500 fish before building back up to over 100,000 in the mid-80s and declining again in the early 90s.

Paint River, including its tributaries Sulukpuk and Dunuletak, contain sockeye (and, in the past, pink salmon (*O. gorbuscha*)) as a result of stocking by Cook Inlet Aquaculture Association. As of the summer of 1994, the Paint River fish ladder, constructed in 1991, had not been opened due to low numbers of returning salmon; thus, this system has no returning adult salmon of any type in it yet.

McNeil River contains Arctic char, chum salmon, some coho salmon (*O. kisutch*), pink salmon, and a few king salmon (*O. tshawytscha*). McNeil River hosts one of the major chum salmon runs in the Lower Cook Inlet area. The river provides approximately 14 miles of chum salmon spawning habitat from the intertidal lagoon upstream to the outlet of McNeil Lake. Fish are unable to move beyond this point due to a series of small but steep falls. Past observations indicate the McNeil River chum salmon run historically peaked in late July. However, like Mikfik Creek, the run timing appears to have shifted, with significant numbers of fish returning in early July. Changes in run timing from year to year are thought to be correlated to the age composition of a given year's return. Runs dominated by five or six year old fish tend to return in late June or early July, while in those years when the dominant portion of the run is composed of four year old fish, the run peaks in mid-July. Generally all three age classes are present in any given years' return, but there is often a slight delay or "lull" in the run between the arrival of early and late components of the return in early July. Other factors can and do affect the timing of fish movement into McNeil River. These include water temperature of the river from melting snow, local weather conditions, magnitude of tidal exchange, changes in water discharge rates from rain and melting snow.

Mikfik Creek has sockeye salmon and Arctic char. Mikfik Creek supports a natural run of sockeye salmon which spawn and rear in a small 120-acre lake located approximately two miles upstream of McNeil Lagoon. The number of salmon returning to this system can be extremely variable with a twenty year annual average of 9,600 sockeye. Historic records indicate the sockeye salmon run to Mikfik Creek occurred from late June to mid-July. In recent times however, run timing has shifted and now fish more commonly return in early June, almost a full month earlier than in historic times. Kamishak River, including Little

Kamishak River and Strike Creek, contain chum salmon, king salmon, sockeye salmon, coho salmon, pink salmon, and Arctic char. Kamishak and Little Kamishak rivers support a twenty year average escapement of approximately 25,000 and 11,000 pink salmon, and 14,000 and 12,000 chum salmon respectively. Kamishak River supports a twenty year average annual escapement of 2,300 sockeye salmon.

Although not formally keyed, fish identified as Arctic char (*Salvelinus alpinus*) in these systems are probably Dolly Varden (*Salvelinus malma*) based on known distribution of both species and physical descriptions (F. DeCicco, pers. commun.).

In addition to the above information, surveys have found lake trout (*Salvelinus namaycush*) in Chenik Lake and rainbow trout (*Salmo gairdneri*) in both the upper Paint River and Mikfik Creek (Aumiller, pers. commun.). The *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* (ADF&G) indicates coho salmon in Mikfik; however, this is erroneous (Aumiller, pers. commun.). Unidentified sculpins and three-spined sticklebacks (*Gasterosteus aculeatus*) have been observed in several freshwater locations in both the sanctuary and refuge (Aumiller, pers. commun.).

## **BIRDS**

At least 130 species of birds have been documented in or within one-half mile of McNeil Lagoon, including nearby marine waters (Table 3). MRS GS staff have been keeping bird sighting records in and near McNeil Lagoon since 1976. In some of those years, abundance, nesting, and migration timing records were also kept (Aumiller, pers. commun.).

The U.S. Fish and Wildlife Service (USFWS) has catalogued seven seabird colonies in the sanctuary and refuge, and islands offshore from the sanctuary or refuge. In the summer of 1978, a boat survey of birds was conducted by the ADF&G of several areas on the west side of Cook Inlet including Kamishak Bay (Arneson 1979). This survey included the seven seabird colonies in or just off shore from the sanctuary or refuge. In 1992, ADF&G sanctuary staff was contracted by the USFWS to once again survey these seven sites (USFWS 1994). Seven species were noted to be nesting on at least one of these sites in each of these surveys (Table 4).

Aerial bird surveys were conducted all four seasons in 1978 by the ADF&G (Arneson 1979). The following comments were made (by season) from that report about areas in or adjacent to the sanctuary or refuge:

**Spring:** "High densities of divers were observed in Akumwarvik Bay. Also, a large raft of scoters and eiders (487 birds/mi<sup>2</sup>) was observed at Chenik Head. High densities of gulls, not associated directly with colonies were on the western shore of Kamishak Bay, where a density of 148 gulls/mi<sup>2</sup> were found."

Summer: "Kamishak Bay with a density of 526 birds/mi<sup>2</sup> had mostly sea ducks (272 birds/mi<sup>2</sup>) and gulls (176 birds/mi<sup>2</sup>) with some alcids (29 birds/mi<sup>2</sup>) and a relatively high cormorant density (18 birds/mi<sup>2</sup>).

Fall: "A fall density of 324 birds/mi<sup>2</sup> in ... the McNeil cove/Akumwarvik Bay area was the second highest in lower Cook Inlet." "Nearly half of the birds were shorebirds (141 birds/mi<sup>2</sup>).\" \"Sea ducks (83 birds/mi<sup>2</sup>) and dabbling ducks (75 birds/mi<sup>2</sup>) made up most of the remainder.\" \"Only 21 gulls/mi<sup>2</sup> were found in that region.\"

Winter: No comments specific to McNeil sanctuary or refuge. This document is the most comprehensive report on coastal birds for the region. It reports not only types of birds (by group) but seasonal abundance and identifies habitat and habitat usage.

The sanctuary and refuge are not known to support large numbers of nesting waterfowl. There are, however, records of green-winged teal, mallards, and northern pintails nesting around McNeil Lagoon. In the spring and, to a lesser degree, the fall, migrating waterfowl stage in McNeil Lagoon (Aumiller, pers. commun).

Bald eagles are seasonally common on McNeil River and Mikfik Creek. Thirty-seven eagles have been seen at one time in McNeil Lagoon (Aumiller, pers. commun). Four active bald eagle nests have been located in the sanctuary despite the general unavailability of suitable nesting trees. Other avian predators such as short eared owls and rough legged hawks, that rely on small mammals for food are relatively numerous in certain locales in the sanctuary and refuge. In summer, the most common birds in the sanctuary and refuge, besides glaucous-winged gulls, are the various warblers and sparrows that nest in open alder-willow plant communities.

## **MARINE MAMMALS**

Because of the shallow, muddy nature of Kamishak Bay and the area's extreme tidal fluctuation, marine mammals are not often observed near shore in either the sanctuary or refuge (Aumiller, pers. commun.). The one exception is harbor seals (*Phoca vitulina*) who commonly follow the migrating salmon on the high tide into McNeil River (Miller 1963, Walker and Aumiller 1993). These seals only remain through high tide and then move seaward as the tide recedes. At low tide the water's edge can be up to 1/2 mile from McNeil Lagoon, eliminating marine mammal access. Beluga whales (*Delphinapterus leucas*) have been observed in the bay once (Stonorov, pers. commun.) and sea otters (*Enhydra lutris*) have been seen twice (Aumiller, pers. commun.) near the McNeil gravel spit at high tide.

## **TERRESTRIAL MAMMALS**

A total of 23 terrestrial mammal species have been identified in the sanctuary and refuge since 1975 by ADF&G staff (Aumiller pers. commun. Table 5). No surveys have been systematically conducted, although several biologists from various agencies have visited the general area (Cahalane 1959; Murie 1959; Miller 1963, 1965, 1966, 1967, and 1968). The sanctuary and refuge are beyond the normal ranges of many large Alaskan mammals. Sitka black-tailed deer, mountain goat, Dall sheep, black bear, muskox, bison, wapiti (elk), and polar bears have not been seen in the sanctuary or refuge. Moose are present in small numbers in both the sanctuary and refuge. Brown bears are seasonally abundant in the sanctuary, but are not abundant in the refuge (Miller 1991). Caribou have been observed in both the sanctuary and refuge but are considered rare (Aumiller, pers. commun.).

Medium-sized mammals are also not well-represented in either the sanctuary or refuge. Red foxes and beaver sightings are fairly common, but wolf, river otter, wolverine, mink, porcupine, snowshoe hare and hoary marmot sightings are rare. Tundra hare, arctic fox, coyote, lynx, and marten have not been noted in the area (Aumiller, pers. commun.).

Systematic sampling of small mammals has not been done in either the sanctuary or refuge, however two species of shrew, a lemming, three species of voles, and a jumping mouse have been identified opportunistically by sanctuary staff (Aumiller, pers commun. Table 5).

### **Brown Bears**

Brown bears are seasonally very abundant at McNeil River falls, lower Mikfik Creek, and McNeil Lagoon (Bledsoe 1987, Walker and Aumiller 1993, Sellers and Aumiller 1994). Elsewhere in the sanctuary and refuge, bear densities are considerably less (Miller 1991). Nearby Katmai National Park has a bear density of approximately 1 bear/mi<sup>2</sup>, which is the highest of any censused area in the state (Miller 1993).

The number of recognizable brown bears (excluding cubs) using the sanctuary has more than doubled from 1979 to the present (Table 6, Aumiller 1994). There are a number of factors that have contributed to this situation. A bear research program in the sanctuary, started by ADF&G in 1962, was completed in 1972. Some bear mortality was associated with the study and, because of the nature of ground darting and handling of bears, the study acted as an aversive conditioning program that discouraged bear use (Sellers and Aumiller 1994). During the same time period, increasing and unregulated public visitation may have also reduced bear numbers (Sellers and Aumiller 1994). But the primary factor may have been the increasing protection from hunting mortality afforded bears in adjoining protected areas (Sellers and Aumiller 1994). The KNPP (formerly Katmai National Monument) was expanded by presidential proclamation in December of 1978 to encompass more than 6,000 mi<sup>2</sup> just south and west of the sanctuary. Three of the eight brown bears that had been

marked by ADF&G were killed by hunters in this area. An additional 115 mi<sup>2</sup> of state land between the sanctuary and the KNPP was closed to brown bear hunting in 1986 by the Alaska Board of Game. Three other marked bears were killed by hunters in this area prior to closure. Thus, by 1986 the expansion of the KNPP and the state closure protected bears in an area where 75% of the previous known harvest of McNeil bears had occurred.

The area north and northwest of the sanctuary including the refuge currently remains open to bear hunting. The harvest rates from this area have generally been considered moderate. Bear hunting in the refuge has been limited to three bears per season since 1991 (open hunting seasons include only October of odd-numbered years and May of even-numbered years). There is, however, evidence to suggest that even with these closures and limited hunts in adjacent areas, the effects of hunting in the remaining open areas on bears using the sanctuary has a dampening effect on population growth. From 1975-91 there was no increase in presence for independent bears (bears not in a family group) following years with sequential fall and spring hunts, compared to a ten percent rate of increase for years when the season was closed (Sellers and Aumiller 1994).

Another important factor that encourages use by bears in the sanctuary is the result of department regulations which strictly limit numbers of human visitors and their activities while in the sanctuary (Aumiller and Matt 1994). In addition, brown bear populations were increasing in most areas of the Alaska Peninsula, not just in or near the sanctuary (Miller and Sellers 1990). Lastly, salmon runs were generally strong in the region throughout the 1980's which also encouraged bear use.

McNeil River first gained attention over 50 years ago because of the high density of bears found in such a small area. In 1967 when the Alaska State Legislature created the sanctuary, protection of this unique concentration was the impetus (C. Tillion, pers. commun.). During the peak of the chum salmon run, brown bear density within the core four square miles around the falls was over 28 bears per square mile (Sellers and Aumiller 1994). Over 100 individual bears have been observed in this core area on several different days. This represents a minimum number, as it does not take into consideration less tolerant bears that fish at McNeil falls during hours when humans are not present nor is a bear counted unless it is one that staff is confident of recognizing a second time (Aumiller, pers. commun.).

Another method to monitor the level of bear use in the sanctuary, besides simply counting the number of individual bears, is to sum the total number of bears seen each day observations are made (Table 7). Staff counts every bear seen and notes where it is seen (Figure 1) in the sanctuary. A bear seen in the sanctuary equates to one bear use day. Hence, if ten bears are seen ten days at McNeil Falls that equals 100 bear use days at McNeil Falls.

Bear use statistics have been kept at the sanctuary since 1980. Use is identified by area, and cubs (of all ages) have been tallied separately. Bear use increased throughout the 1980s paralleling the increase in actual number of individual bears. Peak use occurred in 1989 at 2,300 bear days (excluding cubs) for the whole sanctuary. By 1994, bear use had dropped to 1,661 days (excluding cubs) for the whole sanctuary (Table 6). This represents a 15% decline from the 5-year average and is a 10-year low. The chum salmon run was below minimum escapement levels for the fifth consecutive year (Bucher 1994), and is considered to be a primary reason for declining use by bears.

Bear use on Mikfik Creek in June also continued a 5-year decline and was 29% below the previous 5-year average despite a very good sockeye salmon escapement on Mikfik Creek itself. Presumably, bear use will again increase when McNeil River chum salmon escapements approach levels seen in the 1980s.

The geographic area from which brown bears are attracted to the sanctuary is not fully known (Sellers and Aumiller 1994). There have been, however, several bears marked in the sanctuary from 1962-72 that were subsequently shot or sighted in areas outside the sanctuary (ADF&G unpublished). Prior to 1989, the greatest distance a known McNeil bear was killed or observed from McNeil Falls was about 32 miles. In July of 1989, two adult males appeared at McNeil River Falls with ear tags applied two months earlier, one 48 miles and the other 73 miles straight line distance south of the falls on the coast of Katmai National Park (Sellers and Aumiller 1994).

## **HUMAN USE**

### **ACCESS**

McNeil River State Game Refuge and State Game Sanctuary are accessible by boat or small plane. Floatplanes land in McNeil Cove and in the vicinity of Chenik as well as Paint River Lakes and the lower section of Paint River, and occasionally on Mikfik Lake. Herring spotters land wheel-planes at Chenik in the spring. Commercial fishermen are visitors along the coast during summer months. Commercial sport fish guides bring anglers via floatplane to Kamishak/Little Kamishak rivers for boat fishing. There is no developed public access nor are there any airstrips in either the refuge or sanctuary. Airspace over McNeil River Falls is controlled by FAA and there is a 1,000 foot overflight advisory within two nautical miles of the falls June 1 through September 15 because of heavy concentrations of bears and people. Seaward of signs along McNeil Cove beach, no permit is required to anchor or walk on McNeil Spit.

### **SANCTUARY MANAGEMENT**

Beginning in 1973 the ADF&G Wildlife Conservation Division began to actively manage the bear viewing program at McNeil River Falls. Previously, visitors arrived by plane or boat, camped wherever they desired, including at McNeil Falls, disposed of food or garbage in ways that sometimes attracted bears, and generally had no established guidelines on where to go or how to act around bears (J. Faro, pers commun.). Numbers of bears observed at the falls were declining in the late 1960s and early 1970s and one of the primary reasons was thought to be unregulated visitor use. In 1970, the ADF&G report of brown bear studies states:

"The McNeil River State Game Sanctuary was established to maintain a high number of bears for the public to observe and photograph. Unrestricted public use of the McNeil River Brown Bear Sanctuary has reached a point where it endangers those values which attract observers and photographers. The Department should therefore manage public use in an effort to perpetuate those intrinsic values which make the Sanctuary unique for public enjoyment" (Glenn 1971).

Problems associated with food storage and garbage disposal intensified in 1972. At least four tents were destroyed by bears that year (J. Faro ADF&G monthly report - July 1972). There had also been at least five bears (two females, three cubs) killed directly by visitors or that died as a result of their activities prior to 1972 (Miller 1963, Faro 1970). Safety, not only for humans, but bears as well, was becoming an issue.

An early policy for the management of the sanctuary was drafted in 1976. It was formalized in 1981 (ADF&G 1981). The operational management plan was rewritten and updated in 1993 by the Division of Wildlife Conservation (ADF&G 1993). In addition, the Commissioner has authority to issue up to 15 permits per year for scientific or educational purposes.

The operational management plan included sections on wildlife research and management; bear viewing; bear threshold criteria; hunting, sport fishing, and other recreational activities; fisheries enhancement; commercial fisheries management; traditional, cultural, and historical use; funding; visitor permits and fees; staffing; and reporting as well as establishing goals and objectives (ADF&G 1993).

## **BEAR VIEWING, HABITUATION, AND SAFETY**

Humans have visited McNeil River Falls specifically to look at brown bears since at least the mid-to-late 1940s (G. Effler, pers. commun.). Well over 4,000 people have visited the site since 1973 even though the number of visitors has been strictly limited by law. Currently, ten visitors per day are allowed every four days starting June 7th and running through August 25th. Visitors to the sanctuary are required to have a permit any time they visit throughout the year. The demand is far greater than the available permits, with an average of 1,777 applications received annually from 1990 to 1994. Thus, a lottery drawing is held each year to award permits to visitors that wish to visit one of the bear viewing areas during the summer. In June, a small run of sockeye salmon migrate into Mikfik Creek, which drains into McNeil Cove. Visitors observe bears from a variety of sites on or near the creek with bears catching fish and grazing on tidal vegetation. Mikfik Creek is small and typically attracts only a couple dozen bears. In July and August, chum salmon enter McNeil River and bear activity shifts to McNeil Falls. McNeil River is a large river, accommodating many more salmon and more bears.

The success of the visitor program at McNeil River is largely due to the habituation of bears to people (Aumiller and Matt 1994). Habituation is defined as the reduction in the frequency or strength of response following repeated exposure to inconsequential stimulus (Jope 1985, Gilbert 1989). One type of response by bears toward people is aggression. Elimination or diminishing this response creates a safer environment for interaction. Human actions that encourage habituation in bears also, by virtue of lowering stress levels in bears, encourages them to be comfortable around humans which in turn enhances the viewing program (Aumiller and Matt 1994).

Most of the bears in the sanctuary are neutrally habituated. This means that while they are comfortable around people, they do not seek or receive human food or garbage. A few bears remain wary of humans and none in recent years are conditioned to perceive humans as a source of food (Aumiller and Matt 1994).

By ensuring that humans don't provide food on one hand, nor do they harass or discourage natural behavior in bears on the other, bears are encouraged to use the sanctuary in close proximity to humans in a relatively safe environment.

At the sanctuary, managers found that the objectives of bear protection, quality of viewing and safety (for humans and bears), were compatible (Aumiller and Matt 1994). Managing for the maximum number of bears required limiting the number of visitors and their activities in the sanctuary. Limited visitation required less development and crowding and thus enhanced the visitors' wilderness experience. Most of the actions taken at the sanctuary to encourage more bear use also encouraged habituation.

## **PERMIT SYSTEM**

In 1973, a program to limit visitors to ten per day at the viewing pad at McNeil Falls was initiated (ADF&G 1981). Perhaps as important, this management program also regulated the activities of the visitors. Activities such as where to camp, what to do with garbage, how to store food, how to act when in the presence of bears, and what trails to use, were all addressed in this management plan.

The permit system has been modified several times throughout the 1970s and 1980s to accommodate a growing public demand. In 1983, an application fee of five dollars was required to participate in the permit drawing. In 1987, the application fee was raised to ten dollars and a use fee of forty dollars was required of all permit holders. In 1992, the Board of Game substantially revised sanctuary access regulations and increased the application and user fees. The application fee is now twenty dollars, and if selected, regular use permits have a fee of one hundred dollars for Alaskan residents and two hundred fifty dollars for non-Alaskan residents. The permits are issued by lottery for four-day visits scheduled from June 7 through August 25.

A standby system is also used to ensure that as many visitors get to the bear viewing areas as possible. Until recently there was an informal method for issuing standby permits. The sanctuary manager was contacted by radio or by visiting the sanctuary and, if any vacancies were available, standby permits were issued on a first-come-first-served basis. The demand for these permits, particularly during the peak viewing period, eventually outgrew this simple system. In 1991, standby permits were issued on a first-come-first-served basis to people who telephoned in at a scheduled time. Managing this system was very labor-intensive and therefore costly. However, this method was very efficient at keeping the number of bear viewers near the maximum of ten people per day. A new procedure for issuing standby permits went into effect in 1993. Standby permits are now issued by lottery at the same time as regular bear viewing permits. This is a much less costly and more efficient method. Standby permits have a user fee of fifty dollars for Alaskan residents and one hundred twenty-five dollars for non-Alaskan residents (ADF&G 1993). In addition, the Commissioner has authority to issue up to 15 permits per year for scientific or educational purposes.

## **FISHERIES ENHANCEMENT**

Charles McNeil, for whom McNeil River is named, lived seasonally in McNeil Cove for some years between 1911 and about 1923 (Walker and Aumiller 1993). Although his primary interest was prospecting, he also trapped fur animals, hunted seals, and worked as a salmon stream watchman on local salmon streams (Walker and Aumiller 1993, Mather 1923). Along with Mr. Studdert, he built a "sluice" with rocks and sod wings to funnel salmon up and over the tiny falls on Mikfik Creek. This crude "fish ladder" worked and was

still working in the early 1930s. McNeil is quoted as saying he watched 175 red salmon an hour enter the stream during five hours of high tide (C. McNeil letter courtesy of Eleanor Brown). Mr. McNeil also improved access to Chenik Creek and Amakdedori Creek, both red salmon runs, during this same time period, although he does not document how this was done (C. McNeil letter).

### Mikfik Creek/McNeil River

Agents working for the U.S. Bureau of Fisheries altered the configuration of the falls on "McNeil Creek" in 1932 to enhance salmon passage (Bower, 1933). There has been confusion in recent years as to whether this alteration was done to McNeil River Falls to enhance chum salmon runs or Mikfik Creek Falls to enhance red salmon runs. Some commercial fishermen currently using the area believe it was McNeil Falls that was altered (L. Cabana, pers. commun.). The relevant passage from the stream improvement section of the Alaska fishery and fur-seal industries in 1932 reads "At the upper falls in McNeil Creek, Kamishak Bay, a fishway was blasted out of the solid rock, through which the fish can pass without difficulty into the creek above. A temporary dam was constructed at the crest of the lower falls in this stream, diverting the water to a side channel of comparatively easy ascent." Additional information is available from ADF&G commercial fishery salmon survey files of Kamishak district, McNeil River (ADF&G Homer files). Under the 1932 entry is written, "stream improvement: fishway blasted out of solid conglomerate rock, cut made in rock 3½ foot wide, averaging 30" deep by 15' in length with drop of 20%." It then mentioned an aerial survey done for red salmon that year. In 1936, the same record mentions "fish climbed falls into lake" and another aerial survey was done for red salmon.

The actual physical description of the blast could describe an area on the north side of the upper McNeil River Falls or an area on the north side of lower Mikfik Falls, or even the upper Mikfik Falls considering the area has been through at least one earthquake since 1932 (Aumiller pers. commun.). The fact that it is referred to as "McNeil Creek" does not help support either view because McNeil was always referred to as a river and Mikfik is referred to as a creek in other available early publications (Mather 1923, Orth 1967). Mikfik Creek joins McNeil River in McNeil Lagoon and becomes a tributary to McNeil River at low tide.

The position that alteration was actually done on Mikfik to enhance passage of red salmon is supported by several points. First, in the Bureau of Sport Fishery notation it mentions two falls (an upper and a lower), which best describes Mikfik Creek. McNeil River has a series of riffles and drops over a 100-yard stretch and only the upper extreme of this area impedes fish passage or would be considered a falls (Walker and Aumiller 1993). The lower riffles on McNeil are not conducive to a "temporary dam on its crest" primarily because of the size and volume of the river. Also there is no "side channel at the lower falls" on McNeil but there exists on Mikfik an area at its lower falls which perfectly fits this description.

Secondly, the major species in McNeil River, chum salmon, were not a species that were held in high regard in the early twentieth century. Red salmon catches reported for central Alaska were eight times what chum catches were in 1932 (Bower 1933). No aerial surveys were conducted for chum salmon in the McNeil system until 1950 (including 1932, the year of alteration) but they were conducted for red salmon several times prior to 1950 (ADF&G files, Homer).

Third, in the 1936 aerial survey for red salmon it mentions that the "fish climbed into (the) lake." McNeil has no lake accessible to salmon, while Mikfik does.

Any discussion of where the enhancement was done is probably moot. In over 5,000 hours of observation at McNeil Falls, ADF&G staff report seeing no chum salmon make it over the falls in the area that could have been altered in 1932 (Aumiller, pers. commun.). Very few salmon at all make it over the McNeil Falls in a typical year (Schroeder pers. commun.). Mikfik Creek, however, currently has no barriers to red salmon migration given adequate water levels.

A proposal to introduce an artificial sockeye salmon run into McNeil River and fertilize McNeil Lake was considered and rejected by the ADF&G in 1988. After careful consideration ADF&G Commissioner Don Collinsworth wrote:

"... an enhancement project at McNeil carries with it too many risks which could adversely affect the highly successful bear-viewing program ... the projected benefits are not worth the costs and unknown impacts..." (ADF&G memo to Brian Allee, Lew Pamplin and Ken Parker [Divisional Directors] on 4/13/88 from Don Collinsworth, Commissioner ADF&G).

### Chenik Creek

Other fishery enhancement projects include the mouth of Chenik Creek, which is in the refuge. The outlet of Chenik Creek as it drains into Chenik Lagoon was partially blocked by the 1964 earthquake. It was modified in 1981-82 and again in 1986 by Cook Inlet Aquaculture Association. Hatchery-raised sockeye salmon fry (*Oncorhynchus nerka*) have been and continue to be transplanted into the lake annually and Chenik Lake has been fertilized to increase sockeye numbers. Unfortunately, due to an outbreak of the virus IHN (Infectious Hematopoietic Necrosis), the return of adult sockeye to the system has dropped to very low levels, but is expected to rebound in future years (Bucher, pers. commun.).

### Paint River

The most ambitious fishery enhancement project in either the sanctuary or refuge is the Paint River fish ladder. A forty-foot waterfall exists at the outlet of Paint River that has acted as a barrier to salmon passage. In 1991, Cook Inlet Aquaculture Association built a fish ladder to bypass these falls. From 1991 to 1994, over 20,000 sockeye salmon were expected to return as adults when only a few hundred actually did return (Bucher, pers. commun.). The reason for the low level of return has yet to be determined. Plans for fishery enhancement also include chum salmon stocking.

## **SPORT FISHING**

McNeil River has never been an important river for sport fishermen perhaps because it lacks rainbow trout or catchable numbers of king salmon or silver (*Oncorhynchus Kisutch*) salmon. Dolly Varden (*Salvelinus malma*) and chum salmon (*O. Keta*) have been target species in recent years but sport fishing for these fish has always been incidental to bear watching in the sanctuary.

In the late 1970s concern was expressed by sanctuary managers that some sport fishing was occurring at McNeil Falls after the summer bear viewing season, and the fishermen, who were not used to being around habituated bears, posed a risk to these bears that would not likely move out of their way (Faro, pers. commun.). A second concern of sanctuary staff was that during the summer, sport fishing in McNeil River itself was displacing some bears from gaining access to this very valuable food resource (Aumiller, pers. commun.). There were also safety concerns for both bears and people that would be in close proximity and competing for the same fish.

The legislation creating the sanctuary was clear in its intent. It was to be a true sanctuary for bears and all human use was secondary. Hence, in 1979 the Board of Fisheries closed McNeil River to sport fishing within one-half mile of McNeil Falls. This essentially closed the lower river.

Sport fishing still takes place today from the gravel spit near the campground. Sport fishermen and bears are thus separated. Fishermen are allowed to keep fish caught from the gravel spit but only for immediate consumption in camp.

Kamishak River has been an important sport fishery since the early 1980s. Currently, seven sport fishing lodges have land use permits (the lower one-half mile of Kamishak River is in the sanctuary), from the ADF&G. Six of these lodges reported that 321 anglers caught over 2,721 salmon and Dolly Varden during the summer of 1994. Almost all of these fish were released (ADF&G Sanctuary files 1994 Anchorage, AK). Sport Fish harvest and catch data for the refuge and sanctuary area from 1983 to 1993 are shown in Table 8.

## COMMERCIAL FISHING

Numerous streams in the Kamishak Bay drainage have historically produced salmon in sufficient quantities to support commercial fishing activities. Today salmon returns to rivers within the sanctuary and refuge form an important component of the commercial purse seine fisheries in Lower Cook Inlet. These rivers and the commercial fisheries associated with them fall within the Kamishak Bay District management unit. Marine waters adjacent to the sanctuary and refuge have been further divided into four separate subdistricts in order to facilitate time and area restrictions on the fleet's activities. The various subdistricts can be opened or closed individually or in combination to target the harvest of surplus stocks, while still protecting the runs to achieve adequate spawning escapements.

Many different factors influence the number of fish returning to a river system in any given year including parent-year run strength, genetics, climatic and oceanographic conditions, and potential for interception in other areas. Salmon runs in the Kamishak Bay area are managed by ADF&G's Commercial Fisheries Management & Development Division from the Homer area office. Commercial fisheries biologists frequently conduct low-level aerial surveys throughout the season to estimate the number of spawners returning to the system.

Results from these surveys are used along with harvest information to sustain these runs at optimum levels for the benefit of commercial fishermen as well as bears. The overall objective is to maintain maximum sustained yield on individual stocks within the district.

### Mikfik Creek

A commercial purse seine fishery targeting the Mikfik sockeye stock dates back to the early 1900s. As in many streams and rivers throughout Alaska in the early 1900s, Mikfik Creek sockeye salmon were managed by the Federal Bureau of Commercial Fisheries, who frequently posted "stream guards" at the mouth of the lagoon to protect against "creek robbing". After statehood, the ADF&G's Commercial Fisheries Division became responsible for management of these stocks.

Until 1988, the fishery was managed using an escapement goal of 5,000 fish, the number of adult salmon of both sexes allowed into the system for spawning. The return was gauged from aerial escapement estimates and limited commercial fishing permitted in the bay outside the lagoon. In some years however, large groups of fish returning over short periods of time resulted in massive buildups of fish in McNeil Lagoon and Mikfik Creek early in the run. As a result, frequent special emergency fishery openings inside McNeil Lagoon were necessary to harvest fish excess to escapement needs.

In an attempt to minimize fishing activities in McNeil Lagoon, ADF&G implemented a new management plan beginning in 1988. This plan revised the Mikfik Creek sockeye salmon

escapement goal to a range of 5,000-7,000 fish, and set stricter guidelines on commercial fishing inside McNeil Lagoon. In general, commercial fishing is now regulated to allow adequate and consistent escapement over the course of the run for spawning and to provide fish for bear consumption.

### McNeil River

Commercial purse seining on McNeil River chum stock dates back to the early 1900s and, like Mikfik Creek, was managed by the Federal Bureau of Commercial Fisheries prior to statehood. Commercial harvests occur primarily in McNeil Cove and occasionally inside McNeil Lagoon, which is a traditional safe anchorage for fishing boats.

Present management of the chum salmon run to McNeil River seeks to maintain a healthy salmon population at maximum sustained yield, and to provide fish for bear consumption throughout the course of the run. Identifiable salmon surpluses beyond these requirements are targeted for harvest by the Lower Cook Inlet commercial purse seine fishery. A wide variety of factors can affect run size and timing to produce unexpected results, such as too few or too many fish in the river at a given time. The department strives to regulate the commercial seine fishery on McNeil River chums to achieve an even escapement rate throughout the course of the return to preserve both the natural genetic variability of the run and to provide a consistent supply of fish for bears utilizing McNeil River falls.

Activity of the commercial fishery in the bay just seaward of the intertidal lagoon can affect timing of fish moving into McNeil River. The commercial fishing fleet is normally incapable of completely stopping fish from moving into the river due to variable fishing success in the Kamishak Bay District coupled with a tightly regulated fishing schedule. Harsh weather conditions also play a major role, frequently preventing fishing activities even during open fishing periods.

The commercial fisheries management staff recognizes that bear viewing opportunities in McNeil Sanctuary may be influenced by commercial fisheries activities occurring within or in close proximity to the Sanctuary. In order to minimize the potential for conflicts and enhance visitor safety, management strategy adheres to the Mikfik Creek - McNeil Lagoon Salmon Fishery Management Plan approved by the ADF&G Commissioner in 1988.

### Chenik Lake

Chenik Lake was historically an excellent sockeye salmon producer prior to the 1940s when annual runs approached 150,000 fish. Since that time, however, sockeye salmon runs

declined dramatically forcing complete closure of the Chenik area fishery beginning in 1952. By the mid-70s the annual return to this system was less than 500 fish. In 1978, ADF&G initiated a program to re-establish sockeye salmon returns and subsequently increase commercial fishing opportunities in the Kamishak Bay area. Sockeye salmon fry have been annually stocked in Chenik Lake since that time, and a fish pass was developed at the intertidal mouth of Chenik Creek, alleviating a partial migrational barrier.

Since 1987, lake enrichment has occurred through the application of liquid fertilizer, but not on an annual basis. Increased escapements in the early 1980s strengthened subsequent production, and the Chenik area was re-opened to commercial fishing. Returns in the late 1980s accounted for nearly 50% of the total Lower Cook Inlet commercial sockeye salmon harvest, approaching the historical record high runs of the 1930s.

### Kamishak River

The lower 1/2 mile of the Kamishak River and several miles of the lower Little Kamishak River fall within the boundaries of the sanctuary. These drainages support all five species of salmon, and in many years contribute significant numbers of sockeye, chum, and coho salmon to the commercial purse seine fishery. Catches of salmon bound for these rivers occur in nearby Akumwarvik Bay as well as farther to the east in the Douglas River Subdistrict. The lower Kamishak River also offers one of the few safe anchorages on the west side of Lower Cook Inlet.

## **MINING, MINERAL EXPLORATION, AND CLAIMS**

On the headwaters of Paint River on Crevice Creek, in an area where the Kamishak formation is found, Charles McNeil had his mining claim. It was first filed in 1911 and was called the Reward Group (Walker and Aumiller 1993). By 1923, when Mather visited the site E.H. Holly, McNeil, and others had pending applications for patent on five claims (Mather 1925). Mather noted a number of prospect pits and one tunnel about sixty feet long from which some ore had been extracted - "most of the workings had caved in and many were mere pits in the gossan" (Mather 1925). This mining claim was seventeen miles from the shore of Kamishak Bay. For access, a camp was established in McNeil Lagoon and from there a primitive wagon road stretched six miles to the mouth of Kenty Creek and at that point a horse trail led to the site a short distance below the mouth of Crevice Creek on Paint River. McNeil let his claims lapse sometime after the 1920s.

Interest was revived in the McNeil claims in 1959 when E. Sargent and Associates relocated the claims in the Crevice Creek area. A vigorous prospecting program was then initiated. These claims and workings were examined by the Alaska Territorial Department of Mines in 1953 and 1955 (Jasper 1953, 1956). The claims were apparently abandoned around 1970. There are no current claims near Crevice Creek.

In the summer of 1963, a team of geologists from the State of Alaska, Department of Natural Resources visited the Crevice Creek area to conduct geologic, geochemical, and magnetic studies (Richter and Herried 1965). Approximately twenty-five square miles were surveyed and the principal mineral showings were mapped. In 1991, American Copper and Nickel Company, Inc., and Cominco Mining Company staked several mining claims around the Paint River Lakes system. As of 1994, offshore oil and gas exploration was just beginning. A lease sale is scheduled in the near future for lower Cook Inlet waters and may include areas offshore of the refuge and sanctuary.

## **BROWN BEAR RESEARCH AND PUBLICATIONS**

Two books (Bledsoe 1987, Walker and Aumiller 1993) and a video (A Gathering of Bears, Alaska Video Postcards 1993) have been produced about the bears which use McNeil River. Numerous scientific papers have been written about research conducted in the sanctuary including papers on bear life history (Glenn et al., 1976; Modafferi 1984; Sellers and Aumiller 1994), social behavior (Stonorov 1970, Stonorov and Stokes 1972, Egbert and Stokes 1976, Egbert 1978), fishing behavior (Luque and Stokes 1976, Luque 1978, Aumiller 1995), non-consumptive use programs (Faro and Eide 1974, Aumiller and Matt 1994, Titus et al., 1994), other bear activities including adoption and cub mortality (Erikson 1963, Hessing and Aumiller 1995), and the economic value of the sanctuary (Clayton and Mendelsohn 1993).

Over thirty magazine articles are known to have been written about the bears which seasonally use McNeil River in U.S. publications (Table 9) and at least another ten articles have been written in foreign magazines (Aumiller, pers. commun.).

It would be impossible to tabulate the thousands of published photographs which have been taken in the sanctuary. But it is certain that photographic opportunities have been available and well-utilized (Table 9). One professional photographer estimated that he had over two million photographs in various books and articles of a particular individual bear (Boyd Norton, pers. commun.).

## LAND STATUS

All of the land in the sanctuary and refuge is state-patented or tentatively approved state-land, except 14 sections that encompass Chenik Lake and Chenik Head. These sections, all in the refuge, were jointly selected by the state and Seldovia Native Corporation. A decision regarding final acquisition of these sections is still pending (ADF&G 1994).

The McNeil River State Game Sanctuary was designated a National Natural Landmark in 1967. National Natural Landmarks are areas representing the best examples of the ecological and geographical features comprising our nation's natural history. The National Natural Landmarks Program was established by the National Park Service to help identify and encourage the preservation of these significant areas. The objectives of the program are to encourage the preservation of sites illustrating the geological and ecological character of the United States, to enhance the scientific and educational value of sites thus preserved, to strengthen public appreciation of natural history, and to foster a greater concern in the conservation of the nation's natural heritage.

The National Registry of Natural Landmarks thus provides an important complement to the National Park System for many natural areas of national significance that cannot or need not be acquired by the federal government and managed by the National Park Service. Sites determined to be one of the best examples of a natural region's characteristic biotic or geologic features are considered nationally significant. Department of the Interior standards used to make that determination include primary criteria which consider the illustrative character and present condition of a site and secondary criteria which consider the diversity and rarity of additional features within a site, as well as its value for science and education.

National Natural Landmark designation may be conferred upon sites under any land ownership. Designation does not change the ownership or management of a site, nor does it carry with it any regulations or restrictions regarding its use or future development.

## INFORMATION NEEDS

- Continue periodic brown bear surveys/monitoring of Paint River for baseline data should the fish ladder ever become functional including periodic monitoring of the Paint River Fish Ladder for bear use.
- Conduct a comprehensive inventory and status of sanctuary/refuge birds, mammals, and plants including plant communities.
- Develop and print bird, mammal, and plant checklists.
- Conduct research to better understand the dynamics of fish runs and bear use of fish within the McNeil River State Game Sanctuary and evaluate these data in terms of the relationships between the brown bears which seasonally use McNeil River and commercial fishing operations.
- Continue to conduct surveys of brown bears in the sanctuary to determine bear use trends.
- Conduct an eagle nest survey of the refuge and sanctuary.
- Commercial fishing activity as it relates to the refuge and sanctuary.

**TABLE 1. Flowering plants noted in the sanctuary and refuge.**

**SPECIES**

Family *Cyperaceae* (Sedge Family)

Cottongrass *Eriophorum*

Family *Liliaceae* (Lily Family)

Chocolate Lily *Fritillaria camschatcensis*  
False Hellebore *Veratrum viride eschscholtzii*  
False Asphodel *Tofieldia* spp.

Family *Iridaceae* (Iris Family)

Wild Iris *Iris setosa*

Family *Orchidaceae* (Orchis Family)

Lady's Slipper *Cypripedium guttatum*  
Orchis *Coeloglossum viride bracteatum*

Family *Urticaceae* (Nettle Family)

Nettles *Urtica gracilis*

Family *Polygonaceae* (Buckwheat Family)

Sourdock *Rumex arcticus*  
Mountain Sorrel *Oxyria digyna*  
Bistort *Polygonum bistorta*  
Polygonum *Polygonum viviparum*

Family *Caryophyllaceae* (Pink Family)

Moss Campion *Silene acaulis*  
Minuartia *Minuartia macrocarpa*  
Chickweed *Stellaria sitchana*  
Beach Greens *Honckenya peploides major*

Family *Ranunculaceae* (Crowfoot Family)

Narcissus flowered Anenome *Anenome narcissiflora*  
Marsh Marigold *Caltha palustris*  
Meadow Rue *Thalictrum sparsiflorum*  
Monkshood *Aconitum delphinifolium*

Family *Papaveraceae* (Poppy Family)

Poppy *Papaver alaskanum*

Family *Cruciferae* (Mustard Family)

Kamchatka Rockcress *Arabis lyrata kamchatica*  
Winter Cress *Barbarea orthoceras*  
Draba *Draba borealis*  
Scurvy Grass *Cochlearia officinalis oblongifolia*

Family *Crassulaceae* (Stonecrop Family)

Roseroot *Sedum rosea integrifolium*

Family *Saxifragaceae* (Saxifrage Family)

Spotted Saxifrage *Saxifraga bronchialis*  
Saxifrage *Saxifraga punctata pacifica*  
Northern Water Carpet *Chrysosplenium tetrandrum*  
Bog Saxifrage *Saxifraga hirculus*  
Saxifrage *Saxifraga rivularis flexuosa*  
Grass of Parnassus *Parnassia palustris*  
Alpine Heuchera *Heuchera glabra*

Family *Rosaceae* (Rose Family)

Cloudberry *Rubus chamaemorus*  
Nagoonberry *Rubus arcticus*  
Cinquefoil *Potentilla villosa*  
Shrubby Cinquefoil *Potentilla fruticosa*  
Cinquefoil *Potentilla hyparctica*  
Geum *Geum macrophyllum*  
Pacific Silverweed *Potentilla egedii grandis*  
Salmonberry *Rubus spectabilis*  
Burnet *Sanguisorba menziesii*  
Dryas *Dryas octopetala*  
Two-flowered Cinquefoil *Potentilla biflora*  
Alaska Spiraea *Spiraea Beauverdiana*

Family *Leguminosae* (Pea Family)

Blackish Oxytrope *Oxytropis nigrescens*  
Lupine *Lupinus nootkensis*  
Wild Sweetpea *Lathyrus palustris* (Vetchling)  
Eskimo Potato *Hedysarum lanatum*  
Yellow Oxytrope *Oxytropis maydelliana*  
Oxytrope *Oxytropis viscida*  
Oxytrope *Oxytropis deflexa*

Family *Geraniaceae* (Geranium Family)

Wild Geranium *Geranium erianthum* (Cranesbill)

Family *Violaceae* (Violet Family)

Yellow violet *Viola glabella*  
Yellow violet *Viola biflora*  
Alaska violet *Viola langsдорffii*  
Marsh violet *Viola epipsila*

Family *Onagraceae* (Evening Primrose Family)

Fireweed *Epilobium latifolium* (River beauty)  
Epilobium *Epilobium sertulatum*  
Fireweed *Epilobium angustifolium*

Family *Araliaceae* (Ginseng Family)

Devil's Club *Echinopanax horridum*

Family *Umbelliferae* (Parsley Family)

Angelica *Angelica lucida*  
Cow Parsnip *Heracleum lanatum*  
Beach Lovage *Ligusticum scoticum Hultenii*  
Hemlock Parsley *Conioselinum chinense*

Family *Cornaceae* (Dogwood Family)

Dogwood *Cornus canadensis*

Family *Pyrolaceae* (Wintergreen Family)

Wintergreen *Pyrola asarifolia* (Pink Pyrola)

Family *Ericaceae* (Heath Family)

Labrador Tea *Ledum palustre decumbens*  
Bog Rosemary *Andromeda polifolia*  
Lingonberry *Vaccinium vitis-idaea*  
Alpine Azalea *Loiseleuria procumbens*  
Alpine Blueberry *Vaccinium uliginosum*  
Kamchatka Rhododendron *Rhododendron camtschaticum*  
Bearberry *Arctostaphylos uva-ursi*

Family *Diapensiaceae* (Diapensia Family)

Diapensia *Diapensia lapponica*

Family *Primulaceae* (Primrose Family)

Pixie Eyes *Primula cuneifolia*  
Starflower *Trientalis europaea*  
Rock Jasmine *Androsace chamaejasme*  
Greenland Primrose *Primula egaliksensis*

Family *Gentianaceae* (Gentian Family)

Swertia *Swertia perennis*  
Whitish Gentian *Gentiana algida*

Family *Polemoniaceae* (Polemonium Family)

Jacob's Ladder *Polemonium boreale*  
Tall Jacob's Ladder *Polemonium acutiflorum*

Family *Boraginaceae* (Borage Family)

Oysterleaf *Mertensia maritima*  
Forget-me-not *Myosotis alpestris*

Family *Scrophulariaceae* (Figwort Family)

Woolly Lousewort *Pedicularis kanei*  
Weasel Snout *Lagotis glauca*  
Coastal Paintbrush *Castilleja unalaschcensis*  
Lousewort *Pedicularis langsдорffi arctica*  
Lousewort *Pedicularis verticillata*  
Yellow Monkey Flower *Mimulus guttatus*  
Yellow Rattle *Rhinanthus minor borealis*

Family *Orobanchaceae* (Broomrape Family)

Broomrape *Boschniakia rossica*

Family *Lentibulariaceae* (Bladderwort Family)

Bog Violet *Pinguicula vulgaris* (Butterwort)

Family *Plantaginaceae* (Plantain Family)

Goosetongue *Plantago maritima*

Family *Rubiaceae* (Madder Family)

Northern Bedstraw *Galium boreale*

Family *Caprifoliaceae* (Honeysuckle Family)

High Bush Cranberry *Viburnum edule*  
Elderberry *Sambucus racemosa pubens*  
Twinflower *Linnaea borealis*

Family *Campanulaceae* (Bluebell Family)

Harebell *Campanula lasiocarpa* (Bluebell)

Family *Compositae* (Composite Family)

Pussy Toe *Antennaria rosea*  
Dandelion *Taraxacum trigonolobum*  
Yarrow *Achillea borealis*  
Arnica *Arnica frigida*  
Senecio *Senecio lugens*  
Senecio *Senecio resedifolius*  
Goldenrod *Solidago multiradiata*  
Arnica *Arnica lessingii*  
Wormwood *Artemesia arctica arctica*  
Arctic Daisy *Chrysanthemum arcticum*  
Senecio *Senecio hyperborealis*  
Beach Senecio *Senecio psuedo-Arnica*  
Saussurea *Saussurea angustifolia*  
Pineapple Weed *Matricaria matricarioides*

**TABLE 2. Species found on Amakdedori Beach (Cunning 1977).**

- EUCARDIA (crabs)
  - Oregonia gracilis
  - Telmessus cheiragonus
- OPHIUROIDEA (brittle stars)
  - Ophiopholis aculeata
- HOLOTHUROIDEA (sea cucumbers)
  - Parastichopus californicus
- ECHINOIDEA (sea urchins)
  - Strongylocentrotus drobachiensis
- CIRRIPIEDIA (barnacles)
  - Balanus sp.
  - Chthamalus sp.
  - Lepas sp.
  - Lepas fascicularis
- POLYPLACOPHORA (gumboots)
  - Chrytochiton stelleri
- ASTEROIDEA (sea star)
  - Crossaster papposus
- FISH
  - Gadus macrocephalus
- ALGAE
  - Agarum sp.
  - Alaris sp.
  - Constantinia sp.
  - Desmarestia sp.
  - Eucus sp.
  - Halosaccion sp.
  - Laminaria sp.
  - Nereocystis leutkeana
- GASTROPODA (Limpets)
  - Collisella sp.
  - Punctarella multistriata
- (snails and whelks)
  - Beringius kennicottii
  - Eusitriton oregonensis
  - Thais sp.
  - Thais emarginata
  - Trichotropis insignis
  - Velutina sp.
- BRYOZOA (moss animals)
  - Caulibugula sp.
  - Dendrobeania murropana
  - Dendrobeania multiseriata
  - Elustrella gigantea
  - Terminoflustra membranaceo-truncata
- HYDROID
  - Abietinaria sp.
  - Eucrata loricata
  - Thuiaria sp.
- BIVALVIA (clams, mussels, cockles)
  - Clinocardium nuttalli
  - Hiatella sp.
  - Hiatella arctica
  - Macoma sp.
  - Macoma balthica
  - Modiolus modiolus
  - Musculus discors
  - Mya truncata
  - Mytilus edulis
  - Pododesmus macroschisma
  - Saxidomus giganteus
  - Siliqua alta
  - Siliqua patula
  - Siliqua sp.
  - Tellina lutea
- PORIFERA (sponges)
  - Esperiopsis laxa
  - Halichondria panicea
  - Suberites ficus
- UROCHORDATA (tunicates)
  - Halosynthia aurantium

**TABLE 3. Birds Observed at McNeil River State Game Sanctuary and Adjacent Marine Waters.<sup>1</sup>**

**SPECIES**

Family *Gaviidae*

red-throated loon *Gavia stellata*\*  
Pacific loon *G. pacifica*  
common loon *G. immer*

Family *Falconidae*

American kestrel *Falco sparverius*  
Merlin *F. columbarius*  
peregrine falcon *F. peregrinus*\*  
gyrfalcon *F. rusticolus*

Family *Scolopacidae*

greater yellowlegs *Tringa melanoleuca*\*  
solitary sandpiper *T. solitaria*  
wandering tattler *Heteroscelus incanus*  
spotted sandpiper *Actitis macularia*  
whimbrel *Numerius phaeopus*  
bar-tailed godwit *Limosa lapponica*  
ruddy turnstone *Arenaria interpres*  
black turnstone *A. melanoccephala*  
surfbird *Aphriza virgata*  
red knot *Calidris canutus*  
western sandpiper *C. mauri*  
least sandpiper *C. minutilla*  
pectoral sandpiper *C. melanotos*  
rock sandpiper *C. ptilocnemis*  
dunlin *C. alpina*  
short-billed dowitcher *Limnodromus griseus*  
common snipe *Gallinago gallinago*\*  
red-necked phalarope *Phalaropus lobatus*  
red phalarope *P. fulicaria*

Family *Podicipedidae*

horned grebe *Podiceps auritus*  
red-necked grebe *P. grisegena*

Family *Phasianidae*

willow ptarmigan *Lagopus lagopus*\*  
rock ptarmigan *L. mutus*

Family *Procellariidae*

northern fulmar *Fulmarus glacialis*

Family *Gruidae*

sandhill crane *Grus canadensis*

Family *Hydrobatidae*

fork-tailed storm-petrel *Oceanodroma furcata*

Family *Charadriidae*

black-bellied plover *Pluvialis squatarola*  
lesser golden plover *P. dominica*  
semi-palmated plover *Charadrius semipalmatus*\*

Family *Phalacrocoracidae*

double-crested cormorant *Phalacrocorax auritus*\*  
pelagic cormorant *P. pelagicus*\*

Family *Haematopodidae*

black oystercatcher *Haematopus bachmani*\*

Family *Anatidae*

tundra swan *Cygnus columbianus*  
greater white-fronted goose *Anser albifrons*  
snow goose *Chen caerulescens*  
emperor goose *C. canagica*  
brant *Branta bernicla*  
Canada goose *B. canadensis*  
green-winged teal *Anas crecca*\*  
mallard *A. platyrhynchos*\*  
northern pintail *A. acuta*\*  
northern shoveler *A. clypeata*  
Eurasian wigeon *A. penelope*  
American wigeon *A. americana*  
greater scaup *Aythya marila*  
common eider *Somateria mollissima*  
king eider *S. spectabilis*  
Steller's eider *Polysticta stelleri*  
harlequin duck *Histrionicus histrionicus*\*  
oldsquaw *Clangula hyemalis*  
black scoter *Melanitta nigra*  
surf scoter *M. perspicillata*  
white-winged scoter *M. fusca*\*  
common goldeneye *Bucephala clangula*  
Barrow's goldeneye *B. islandica*  
common merganser *Mergus merganser*  
red-breasted merganser *M. serrator*\*

Family *Laridae*

parasitic jaeger *Stercorarius parasiticus*  
Bonaparte's gull *Larus philadelphia*\*  
mew gull *L. canus*\*  
herring gull *L. argentatus*\*  
glaucous-winged gull *L. glaucescens*\*  
black-legged kittiwake *Rissa tridactyla*\*  
Sabine's gull *Xema sabini*  
Arctic tern *Sterna paradisaea*  
Aleutian tern *S. aleutica*

Family *Accipitridae*

osprey *Pandion haliaetus*  
bald eagle *Haliaeetus leucocephalus*\*  
golden eagle *Aquila chrysaetos*  
northern harrier *Circus cyaneus*\*  
sharp-shinned hawk *Accipiter striatus*  
rough-legged hawk *Buteo lagopus*\*

Family *Motacillidae*

American pipit *Anthus rubescens*\*

Family *Alcidae*

common murre *Uria aalge*\*  
pigeon guillemot *Cephus columba*\*  
marbled murrelet *Brachyramphus marmoratus*  
parakeet auklet *Cyclorhynchus psittacula*  
crested auklet *Aethia cristatella*  
tufted puffin *Fratercula cirrhata*\*  
horned puffin *F. corniculata*\*

Family *Bombycillidae*

Bohemian waxwing *Bombycilla garrulus*

Family *Laniidae*

northern shrike *Lanius excubia*

Family *Columbidae*

domestic pigeon (banded)

Family *Strigidae*

northern hawk owl *Surnia ulula*  
short-eared owl *Asio flammeus*\*

Family *Alcedinidae*

belted kingfisher *Ceryle alcyon*

Family *Picidae*

northern flicker *Colaptes auratus*

Family *Hirundinidae*

tree swallow *Tachycineta bicolor*\*  
violet-green swallow *T. thalassina*  
bank swallow *Riparia riparia*\*  
cliff swallow *Hirundo pyrrhonota*\*

Family *Cinclidae*

American dipper *Cinclus mesicanus*\*

Family *Emberzidae*

orange-crowned warbler *Vermivora celatay*\*  
yellow warbler *Dendroica petechia*\*  
yellow-rumped warbler *D. coronata*\*  
blackpole warbler *D. striata*  
northern waterthrush *Seiurus noveboracensis*\*  
Wilson's warbler *Wilsonia pusilla*\*  
American tree sparrow *Spizella arborea*\*  
Savannah sparrow *Passereulus sandwichensis*\*  
fox sparrow *Passerella iliaca*\*  
song sparrow *Melospiza melodia*  
golden-crowned sparrow *Zonotrichia atricapilla*\*  
white-crowned sparrow *Z. leucophrys*  
dark-eyed junco *Junco hyemalis*  
Lapland longspur *Calcarius lapponicus*  
snow bunting *Plectrophenax nivalis*  
McKay's bunting *Plectrophenax nivalis*  
rusty blackbird *Euphagus carolinus*

Family *Fringillidae*

rosy finch *Leucosticte arctoa*  
pine grosbeak *Pinicola enucleator*  
common redpoll *carduelis flammea*

Family *Corvidae*

gray jay *Perisoreus canadensis*  
black-billed magpie *Pica Pica*\*  
northwestern crow *Corvus caurinus*  
common raven *C. corax*\*

Family *Paridae*

black-capped chickadee *Parus atricapillus*  
boreal chickadee *P. hudsonicus*

Family *Muscicapidae*

ruby-crowned kinglet *Regulus calendula*  
gray-cheeked thrush *Catharus minimus*\*  
hermit thrush *C. guttatus*\*  
American robin *Turdus migratorius*\*  
varied thrush *Ixoreus naevius*

OTHER BIRDS EXPECTED

red-faced cormorant *Phalacrocorax urile*  
Kittlitz's murrelet *Brachyramphus brevirostris*<sup>+</sup>  
thick-billed murre *Uria lomvia*<sup>+</sup>

<sup>1</sup>Bird species were compiled by Larry Aumiller, Polly Hessing, and Colleen Matt from 1976 to 1994. Observations were made as early as May 1 and as late as October 30, but were generally made between early-June and late-August.

\* = Nesting

<sup>+</sup> = Observed near Chenik Head - (L. Johnson, pers. commun.)

**TABLE 4.            Seabird Nesting Colonies On or Offshore from McNeil River State Game Sanctuary or State Game Refuge.**

1. Nordyke Island (FWS colony No. 51-001)
  - Glaucous-winged gull
  - Tufted puffin
  - Pigeon guillemot
  - Black oystercatcher
  - Double-crested cormorant
2. Akumwarvik Bay (FWS colony No. 51-005)
  - Glaucous-winged gull
  - Pigeon guillemot
3. McNeil Islet (FWS colony No. 51-007)
  - Common murre
4. McNeil Cove (FWS colony No. 51-008)
  - Double-crested cormorant
  - Pigeon guillemot
  - Horned puffin
  - Glaucous-winged gull
5. Amakdedulia Cove (FWS colony No. 51-009)
  - Double-crested cormorant
  - Tufted puffin
  - Glaucous-winged gull
6. Amakdedulia Island (FWS colony No. 51-010)
  - Black oystercatcher
  - Glaucous-winged gull
7. McNeil Head (FWS colony No. 51-034)
  - Double-crested cormorant
  - Glaucous-winged gull
8. Paint River (FWS colony No. 51-035)
  - Glaucous-winged gull

**TABLE 5. Mammals Observed at McNeil River State Game Sanctuary<sup>1</sup>.**

Common Name	Scientific Name
Masked Shrew	<i>Sorex cinereus</i>
Dusky shrew	<i>Sorex monticolus</i>
Little brown bat	<i>Myotis lucifuga</i> <sup>*</sup>
Snowshoe hare	<i>Lepus americanus</i> <sup>*</sup>
Hoary marmot	<i>Marmota caligata</i>
Arctic ground squirrel	<i>Spermophilus parryii</i>
Beaver	<i>Castor canadensis</i>
Brown lemming	<i>Lemmus trimucronatus</i>
Northern red backed vole	<i>Clethrionomys rutilus</i>
Meadow vole	<i>Microtus pennsylvanicus</i>
Tundra vole	<i>Microtus oeconomus</i>
Muskrat	<i>Ondatra zibethicus</i> <sup>*</sup>
Meadow jumping mouse	<i>Zapus hudsonius</i>
Porcupine	<i>Erethizon dorsatum</i> <sup>*</sup>
Short-tailed weasel/ermine	<i>Mustela erminea</i> <sup>*</sup>
Mink	<i>Mustela vison</i> <sup>*</sup>
River otter	<i>Lutra canadensis</i>
Red fox	<i>Vulpes vulpes</i>
Wolverine	<i>Gulo gulo</i> <sup>*</sup>
Gray wolf	<i>Canis lupus</i> <sup>*</sup>
Brown bear	<i>Ursus arctos</i>
Moose	<i>Alces alces</i>
Caribou	<i>Rangifer tarandus</i> <sup>*</sup>
Sea otter	<i>Enhydra lutris</i> <sup>+</sup>
Harbor seal	<i>Phoca vitulina</i> <sup>+</sup>
Beluga	<i>Delphinapterus leucas</i> <sup>+</sup>

<sup>1</sup>Mammal sightings were generally made from late May through early Sept. 1976-1994 (Aumiller, pers. commun.).

<sup>\*</sup> =Rare or unusual sightings.

<sup>+</sup> =Seen in McNeil Lagoon or nearby marine waters.

**TABLE 6. Sex and Age Composition of Brown Bears at McNeil River State Game Sanctuary: 1974-1994<sup>1</sup>**

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total Females w/cubs	7	10	9	10	8	9	6	8	7	7	9	16	14	14	14	19	16	15	16	11	11
Single Adult Females	4	9	5	8	6	8	8	10	9	15	16	12	11	13	13	14	16	12	19	19	15
Single Adult Males	19	9	16	18	18	19	23	26	20	22	22	27	31	34	34	42	37	41	39	48	45
Adult Sex Unknown	1	14	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total Adults</b>	<b>31</b>	<b>42</b>	<b>31</b>	<b>36</b>	<b>32</b>	<b>36</b>	<b>38</b>	<b>44</b>	<b>36</b>	<b>44</b>	<b>47</b>	<b>55</b>	<b>56</b>	<b>61</b>	<b>61</b>	<b>75</b>	<b>69</b>	<b>68</b>	<b>74</b>	<b>78</b>	<b>71</b>
Subadult Females	5	--	4	3	4	2	6	9	11	9	8	2	7	7	9	4	5	6	6	8	9
Subadult Males	3	--	0	5	4	0	0	1	1	4	5	10	7	8	8	5	5	4	2	4	3
Subadult Sex Unknown	1	--	3	4	5	3	4	5	3	1	0	0	0	0	0	0	0	0	0	0	0
<b>Total Sub-adults<sup>2</sup></b>	<b>9</b>	<b>--</b>	<b>7</b>	<b>12</b>	<b>13</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>14</b>	<b>13</b>	<b>12</b>	<b>14</b>	<b>15</b>	<b>17</b>	<b>9</b>	<b>10</b>	<b>10</b>	<b>8</b>	<b>12</b>	<b>12</b>
Adults/Sub-adults Total	40	42	38	48	45	41	48	59	51	58	60	67	70	76	78	84	79	78	82	90	83
<b>Total Cubs<sup>3</sup></b>	<b>25</b>	<b>20</b>	<b>20</b>	<b>21</b>	<b>20</b>	<b>17</b>	<b>12</b>	<b>14</b>	<b>16</b>	<b>12</b>	<b>17</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>31</b>	<b>42</b>	<b>34</b>	<b>30</b>	<b>31</b>	<b>24</b>	<b>22</b>
<b>Total Bears</b>	<b>65</b>	<b>62</b>	<b>58</b>	<b>69</b>	<b>65</b>	<b>58</b>	<b>60</b>	<b>73</b>	<b>67</b>	<b>70</b>	<b>77</b>	<b>95</b>	<b>96</b>	<b>106</b>	<b>109</b>	<b>126</b>	<b>113</b>	<b>108</b>	<b>113</b>	<b>114</b>	<b>105</b>

<sup>1</sup>Only the bears that are recognizable as individuals and given names are included. Hence these figures represent minimum number of bears present at the sanctuary.

<sup>2</sup>Defined as 5.5 years old and younger from 1977 through the present.

<sup>3</sup>Total cubs = offspring of any age associated with a female.

**TABLE 7. McNeil River State Game Sanctuary Bear Use Totals for June, July and August (does not include May or Sept. use).**

McNeil Falls				Lower McNeil River			Mikfik Creek			All Other Areas (flats, bluffs, etc.)			Total Bear Use		
	Adult/ Subadult	All Cubs	<b>Total</b>	Adult/ Subadult	All Cubs	<b>Total</b>	Adult/ Subadult	All Cubs	<b>Total</b>	Adult/ Subadult	All Cubs	<b>Total</b>	Adult/ Subadult	All Cubs	<b>Total</b>
1980	709	140	849	14	15	29	46	21	37	162	56	218	924	218	1142
1981	878	224	1102	-	-	-	18	21	39	77	63	140	973	308	1281
1982	925	142	1067	21	9	30	28	2	30	83	33	116	1054	186	1241
1983	926	172	1098	-	-	-	8	0	8	100	41	141	1032	213	1245
1984	1218	274	1492	50	9	59	43	0	43	123	39	162	1432	322	1754
1985	1514	451	1965	37	31	68	150	56	206	195	100	295	1888	642	2530
1986	1649	494	2143	34	42	76	192	126	318	214	172	386	2061	825	2886
1987	1723	465	2188	9	12	21	235	86	321	161	152	313	2126	715	2841
1988	1515	417	1932	30	40	70	201	28	229	142	48	190	1873	524	2397
1989	1863	699	2562	119	80	199	156	71	227	174	189	363	2300	1032	3332
1990	1606	551	2157	76	57	133	229	159	388	264	251	515	2089	936	3025
1991	1393	388	1781	1	0	1	428	120	548	246	138	384	2039	631	2671
1992	1510	480	1990	3	6	9	385	115	500	178	139	317	2075	738	2813
1993	1240	86	1326	94	57	151	234	26	260	358	164	522	1921	227	2248
1994	1165	125	1290	95	59	154	212	29	241	208	103	311	1661	307	1968

•Each time a recognizable bear is seen in an area of the sanctuary, it is counted as one bear use day for that area. Hence, if 10 different bears are seen at McNeil Falls 10 days in a row, that equals 100 bear use days for McNeil Falls.

The total bears column may be less than the sum of the first four columns if a bear is counted using more than one area in the same day. Bears are noted opportunistically and figures reflect not only actual bear use but to some degree the amount of time spent viewing.

•McNeil Falls sightings are made from the viewing pad and include any recognizable bear no matter where it is or how far down stream it is.

•Lower McNeil River sightings are made from the mouth of McNeil River, generally from Enders Island. Viewing occurs here in mid to late July after bear activity ceases at McNeil Falls. Little or no time was spent viewing here from 1980-1983.

•Mikfik Creek is defined as the area up creek from the last area of tidal influence, including the area referred to as the “riffles”.

•All other areas includes anywhere in McNeil Cove that is not included in the first three categories. This includes the sedge flats, beach, by camp, or on any of the bluff areas. Through the years notations of bear use in these areas has been very casual as very little time comparatively is spent systematically bear watching away from the first three areas.

**TABLE 8. Sport fish harvest and catch data from Statewide Harvest Survey (Mills), 1983-1993.**

	1983	1984	1985	1986	1987	1988	1989	1990		1991		1992		1993		1994	
	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest
<b>Kamishak Bay boat</b>																	
Effort	0	0	52	0	02	500	16	118	118	201	201	112	112	506	506	565	565
Pink salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	216	0	0	0
Chum salmon	0	0	50	0	0	0	0	0	0	0	0	0	0	8	8	0	0
Silver salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Dolly Varden	0	0	0	0	0	0	0	0	0	0	0	0	0	26	26	0	0
Halibut	0	0	0	0	217	265	10	500	128	518	215	202	125	1 087	608	711	175
Lingcod	0	0	0	0	0	0	0	0	0	11	11	56	0	15	27	65	0
<b>Kamishak Bay shore</b>																	
Effort	0	0	0	0	31	0	0	33	33	17	17	0	0	0	0	0	0
Pink salmon	0	0	0	0	0	0	0	0	0	33	33	0	0	0	0	0	0
Chum salmon	0	0	0	0	0	0	0	0	0	17	17	0	0	0	0	0	0
Silver salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dolly Varden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Halibut	0	0	0	0	36	0	0	171	70	0	0	0	0	0	0	0	0
<b>Amakdedari Creek</b>																	
Effort	17	0	17	0	0	0	31	0	51	24	24	0	0	80	80	13	13
Pink salmon	0	0	0	0	0	0	0	0	0	11	11	0	0	13	0	0	0
Silver salmon	0	0	0	0	0	0	0	55	55	0	0	0	0	512	120	100	30
Red salmon	0	0	0	0	0	0	13	0	0	20	20	0	0	0	0	0	0
Dolly Varden	0	0	0	0	0	0	0	51	51	0	0	0	0	175	18	0	0
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0
<b>Kamishak Diver</b>																	
Effort	0	100	381	0	0	0	0	11	11	0	0	117	117	701	701	272	272
Silver salmon	0	112	100	0	0	0	0	220	0	0	0	202	57	535	76	121	51
Red salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	06	0	0	0
Pink salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	21	8
Chum salmon	0	0	75	0	0	0	0	0	0	0	0	68	0	701	0	221	0
Dolly Varden	0	0	52	0	0	0	0	671	67	0	0	360	0	2 112	38	112	0
Rainbow trout	0	0	0	0	0	0	0	0	0	0	0	110	0	603	10	0	0
Arctic grayling	0	0	0	0	0	0	0	0	0	0	0	225	0	0	0	0	0
<b>McNeil Diver</b>																	
Effort	31	0	0	0	72	100	16	76	76	0	0	0	0	71	71	26	26
Silver salmon	0	0	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0
Pink salmon	0	0	0	0	0	182	0	0	0	0	0	0	0	0	0	0	0
Chum salmon	12	0	0	0	18	182	0	0	0	0	0	0	0	131	0	0	0
Dolly Varden	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0

## Chenik Lake

[illegible]

## Chenik River

Effort	80	0	0	76	0	0	16	0	0	0	0	160	160	0	0	0	0
Red salmon	96	0	0	80	0	0	0	0	0	0	0	25	25	0	0	0	0
Lake trout	0	0	0	0	0	0	0	0	0	0	0	77	77	0	0	0	0

## Little Kamichak River

[illegible]

**TABLE 9. Magazine Articles Written About the McNeil River State Game Sanctuary and the Bears.**

1954	Aug.	<u>The National Geographic Magazine</u> .	When giant Alaskan bears go fishing.	Cecil R. Rhode.
1955	Sept.	<u>Outdoor Life</u> .	I lived with the bears.	Cecil E. Rhode.
1963	Jan.	<u>Natural History</u> .	Solitary carnivore.	Milton B. Trautman.
1971	Oct.	<u>Alaska</u> .	The brown bears of McNeil River.	James B. Faro.
1971	Nov./Dec.	<u>Alaska Fish and Game Trails</u> .	McNeil River Bear Search.	Jim Faro.
1972	Nov.	<u>Natural History</u> .	Protocol at the annual brown bear fish feast.	Derek Stonorov.
1974	Mar./Apr.	<u>Alaska Fish and Game Trails</u> .	McNeil River, it's for the bears.	Jim Faro.
1975	May	<u>Audubon</u>	The social life of an unsociable giant.	Wade T. Bledsoe, Jr.
1975	Sept.	<u>The National Geographic Magazine</u> .	Alaska's big brown bears.	A. Egbert and M. Luque.
1977	Spring	<u>The Beaver</u> .	The fishing bears.	Fred Bruemmer.
1979	Mar./Apr.	<u>Alaska Fish and Game Trails</u> .	The bears of McNeil River.	Chris Smith.
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